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1960-1961

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THE Association was organized in Boston, Mass., on June 21, 1882, with the object of providing its members with means of social intercourse and for the exchange of knowledge pertaining to the construction and management of water works. From an original membership of only TWENTY-SEVEN, its growth has prospered until now it includes the names of over 1000 men. Its membership is divided into six classes, viz.:

A Member shall be an officer or employee of a public or private water works, an engineer, chemist or other person qualified to aid or interested in the advancement of knowledge relative to water works.

An Honorary Member shall be a person of acknowledged eminence in some branch of water supply or of engineering.

A Junior shall be not less than eighteen years nor more than twenty-five years of age, a student or connected with water supply work.

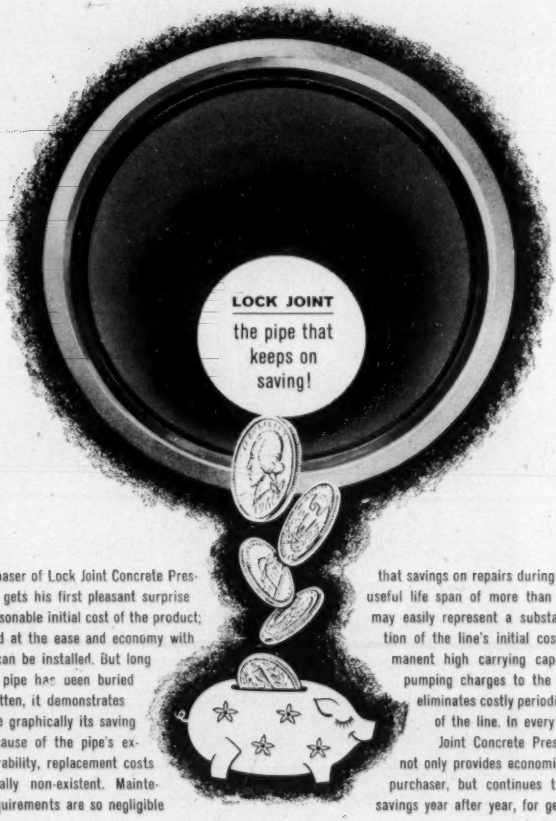
An Associate shall be either a person, firm or corporation engaged in manufacturing or furnishing materials or supplies for the construction or maintenance of water works.

A Corporate Member shall be either a Water Board, Commission, Company or Municipal Corporation.

The initiation fees and annual dues are as follows:

Initiation Fees		*Annual Dues*	
Members	$ 3.00	Members	$ 8.00
Juniors	1.00	Juniors	3.00
Associates	10.00	Associate	25.00
Corporate Members	10.00	Corporate Members	15.00

This Association has at least eight regular meetings each year, of which five are held in Boston, one in northern New England, one in southern New England, and one, the annual convention, held in September or October on such date as the Executive Committee may designate.



The purchaser of Lock Joint Concrete Pressure Pipe gets his first pleasant surprise at the reasonable initial cost of the product; his second at the ease and economy with which it can be installed. But long after the pipe has been buried and forgotten, it demonstrates even more graphically its saving ways. Because of the pipe's extreme durability, replacement costs are virtually non-existent. Maintenance requirements are so negligible that savings on repairs during the pipe's useful life span of more than 100 years may easily represent a substantial portion of the line's initial cost. Its permanent high carrying capacity cuts pumping charges to the bone and eliminates costly periodic cleaning of the line. In every way Lock Joint Concrete Pressure Pipe not only provides economies for the purchaser, but continues to pile up savings year after year, for generations.

LOCK JOINT
MADE ITS WAY BY THE WAY IT'S MADE
CONCRETE PIPE

LOCK JOINT PIPE CO.

East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn.
Kansas City, Kan. • Perryman, Md. • St. Paul, Minn. • Winter Park, Fla.

Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous

Vol.
196

GOES TO BED WITH ITS WORKING CLOTHES ON

From the moment it is installed, cast iron pipe begins working—will deliver its full flow of water for over a century.

Here in Kansas, as part of a major water expansion program, 15,000 feet of cast iron pipe were put to bed. Ease of assembly, bottle-tight joints, and assured full-flow capacity through cement lining were important factors in the selection of cast iron pipe.

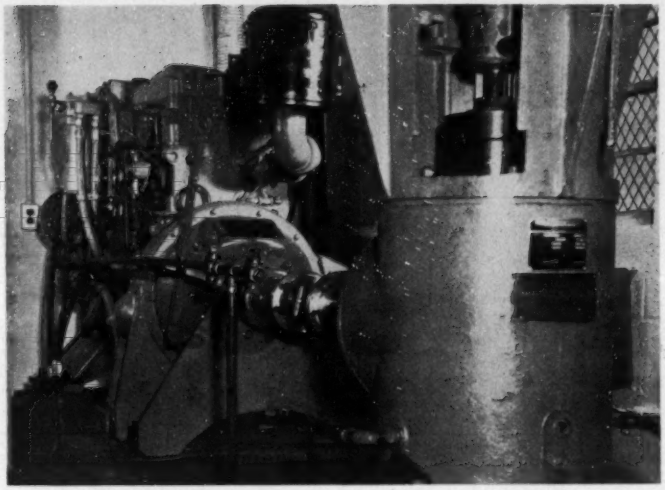
An interesting feature was the uncovering of distribution mains constructed of cast iron pipe manufactured in 1887. The pipe was in excellent condition and was put back in water service.

Cast iron pipe is always working. In fact, once it is installed, one can generally anticipate no major repairs or replacements for at least a century.

CAST IRON PIPE RESEARCH ASSOCIATION
Thos. F. Wolfe, Managing Director
3440 Prudential Plaza, Chicago 1, Illinois

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE



DIESEL ENGINE DRIVEN PUMP UNIT
WATER PUMPING STATION
TOWN OF AMHERST, MASSACHUSETTS

This Cummins Diesel engine, rated 122 horsepower for continuous service at 1800 RPM, provides stand-by power for the new water pumping station in Amherst, Massachusetts. Tighe & Bond of Holyoke, Massachusetts, were the engineers for this application, which is capable of discharging 1,000,000 gallons per day at a head of 155 PSI.

Contractors for the installation of the pump and diesel engine were R. H. White Construction Co., Inc., Auburn, Massachusetts.

CUMMINS DIESEL OF NEW ENGLAND, INC.

201 Cambridge Street
Allston 34, Massachusetts

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South Portland, Maine

720 Union Street
West Springfield, Mass.

ONLY MATHEWS HAS ALL THE DESIRABLE FEATURES

What do you look for in a hydrant? Dependability? . . . replaceable barrel? . . . conventional packing? . . . "O" ring seal? . . . stop nut to prevent stem from buckling? We could double this list and still not cover all the features we build into Mathews Hydrants *by design*. Mathews has them all.

DEPENDABILITY

Mathews Hydrants are always ready for service, because their design is fundamentally sound and simple. In 90 years we have never changed the basic design—only refined it, by detail.

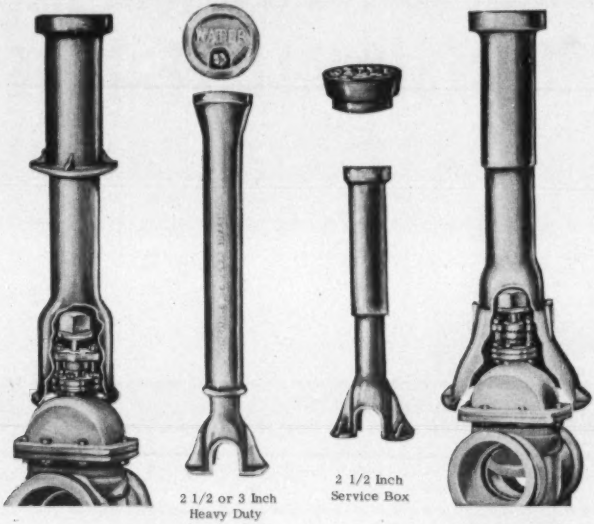
AND ALL THESE OTHER FEATURES, TOO:
All working parts contained in replaceable barrel • Head can be faced in any direction • Replaceable head • Any nozzles you specify • Nozzle levels raised or lowered without excavating • Leakproof because stuffing box is cast integral with nozzle section • Operating thread only part requiring lubrication • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • Available with bell, mechanical joint or flange pipe connections

Conform to latest AWWA specifications

R. D. WOOD COMPANY

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers also of Mathews Flange Barrel Hydrants, R. D. Wood Hydrants, R. D. Wood Gate Valves, and "Sand-Spun" Pipe (centrifugally cast in sand molds)



2 Piece Sliding Type Adjustable Valve Box

2 1/2 or 3 Inch Heavy Duty Service Box

2 1/2 Inch Service Box

3 Piece Screw Type Adjustable Valve Box

The Three "Bigs" in Buying

1. *Standardization*
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3. *Quick Delivery*

ESTABLISHED 1849

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CORPORATION

GENUINE BUFFALO
CAST IRON SERVICE, VALVE, ROADWAY AND METER BOXES

MANHOLE FRAMES AND COVERS

CULPEPER, VA.

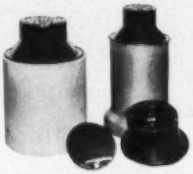
FOUR reasons why Ford covers offer greater protection and convenience for every meter box installation . . .

1 2 3 4

DOUBLE LID METER BOX COVERS

Designed to provide the utmost in frost protection for pit meters, the "Wabash Cover" has a total depth of 9½ inches. Its extra depth, sloping skirt and 4" dead-air space between inner lid and top lid minimize heat loss from the top of the meter setting.

These covers can be provided in "standard weight" for ordinary service, or "extra heavy," when the lid will be exposed to traffic.



SINGLE LID METER BOX COVERS

Designed for sidewalk or lawn installation, Ford "Type A" covers are made for 15", 18", 20" and 21" meter boxes. Lids are inset.

Lifter Worm lock used on these covers helps speed meter readings. Screw jack action plus automatic attachment of the key to the bolthead make lid removal a simple, clean task.

MONITOR COVER

Designed for use on large tile — where a large lid opening is desirable — "Monitor Covers" consist of 1) a flange casting to fit on the tile, 2) a ring centered in place on the flange by a circular bead, and 3) a top lid with Lifter Worm Lock.

These covers can be used for 1½" and 2" meters . . . or for two or more smaller meters. Lid size permits meter reader to enter setting if necessary.

HINGED LID

Designed for same installations as other single lid covers, "Type X cover" features hinge effect so lid can simply be leaned back instead of lifted off while meter is read.

Simple, ingenious lugs in the frame casting pivot the lid and support it. Thus, if desired, it can also be completely lifted off.

For more information, write . . .

FOR BETTER WATER SERVICES

FORD

THE FORD METER BOX COMPANY, INC. Wabash, Indiana

AFTER 12 YEARS 1947 1959 OF RESEARCH AND 45,000 OPEN-CLOSE TESTS, THE MUELLER® ORISEAL® CURB VALVE HAS GONE TO WORK. AND ON THE JOB, AS IN THE TESTS, THE ORISEAL HAS PROVEN LEAKPROOF IN SPITE OF REPEATED USE OR PROLONGED IDLENESS. THE "TEFLON"* COATED PLUG O RETAINS ALL ITS LUBRICATING QUALITIES IN ALL CONDITIONS. EVEN THE 2" ORISEAL VALVE IS OPERATED WITH JUST A 12" WRENCH—UNDER 125 P.S.I. ONCE INSTALLED, THE ORISEAL SELDOM NEEDS ATTENTION—THE LINE WILL PROBABLY BE REPLACED BEFORE THE ORISEAL WILL REQUIRE SERVICING!

WRITE FOR MORE FACTS ON THE ORISEAL CURB VALVE OR ASK YOUR MUELLER REPRESENTATIVE.

NEW CURB BOX *for the* **ORISEAL**

ORISEAL CURB VALVE

SIZES
¾", 1", 1¼", 1½", 2"

MUELLER CO. Since 1857 SERVING the Water-Works Industry QUALITY

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited, Sarnia, Ontario

*DuPont Company registered trademark

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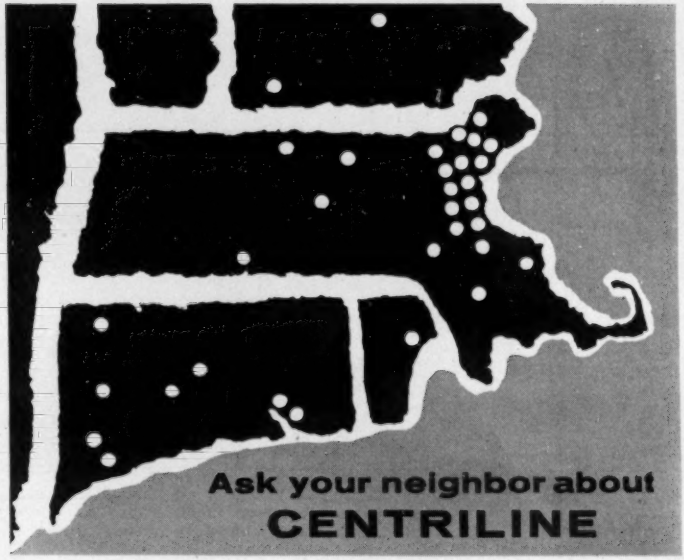


Spotted on this map are some of the places that have been served by the Centriline Process

Chances are that one of your colleagues has rejuvenated some of his city's piping by Centriline reconditioning. Here's your chance to find out.

Briefly, this process smoothly lines piping—*in place*—with cement-mortar, creating a pipe-within-a-pipe. This vastly increases carrying capacity, stops leakage, prevents corrosion and tuberculation, and prolongs pipe life indefinitely. Pressure goes up, pumping cost goes down, and there's no need to disturb traffic to replace mains. Over 6,000,000 feet of piping, from 4" to 144" diameter, have been treated by Centriline. *Ask your neighbor.*

Write today for a list of nearby officials whose cities have cut inconvenience and costs with this pipe-saving process. Hear what they have to say about Centriline. Then write or call us. We'll be glad to show you how Centriline can help *you* solve the problems of pipe reconditioning in place.

CENTRILINE CORPORATION

A Subsidiary of Raymond International Inc.

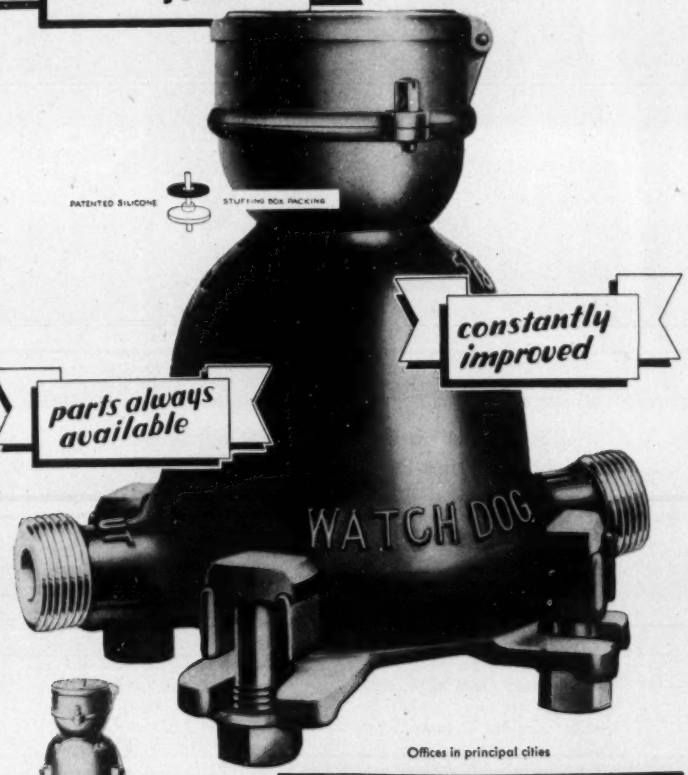
140 CEDAR STREET • NEW YORK 6, N. Y.

Branch offices in principal cities of the United States, Canada, and Latin America.

longer life

constantly improved

parts always available



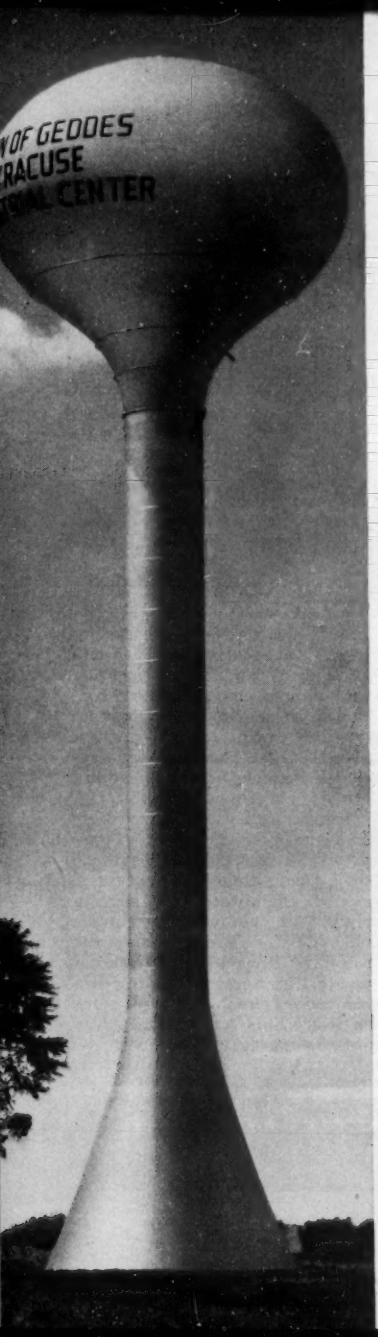
Split case or frost proof

Offices in principal cities

GAMON METER DIVISION

NEWARK NEW JERSEY

WORTHINGTON



why

Geddes, N. Y.

went

14 STORIES HIGH

to assure

better water service

for new industries

PDM
ELEVATED STEEL TANKS

PEDESTAL SPHEROID ELEVATED STEEL TANKS

This 147-foot PDM Pedestal Spheroid—world's highest tank of its type, so far as is known—brings a 500,000-gallon water capacity into balance with Geddes' expanding supply system. Serving the Syracuse industrial area with assurance of ample water facilities for new industries a-coming, the new PDM unit ties in with a 100,000-gallon tank 3 miles away for effective pressure equalization. Is *your* community preparing for increasing water demands?

Let a PDM representative work with you, at no obligation.

PITTSBURGH - DES MOINES STEEL CO.

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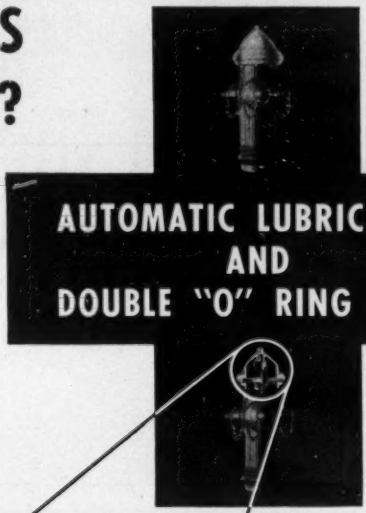
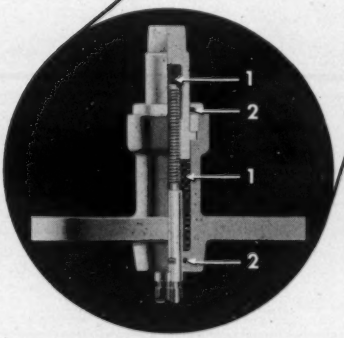
BIRMINGHAM (8)	P. O. Box 8641, Ensley Station	BALTIMORE
DES MOINES (8)	1015 Tuttle Street	BIRMINGHAM
PROVO, UTAH	P. O. Box 310	DES MOINES
SANTA CLARA, CALIF.	P. O. Box 329	PROVO, UTAH
EL MONTE, CALIF.	P. O. Box 2012	CASPER, WYO.
NEW YORK (17)	200 East 42nd Street	SANTA CLARA
NEWARK (2)	744 Broad Street	FRESNO
CHICAGO (3)	679 First National Bank Bldg.	STOCKTON, CALIF.
ATLANTA (5)	361 East Paces Ferry Rd., N. E.	
DALLAS (1)	Suite 1703, Southland Center	
DENVER (2)	323 Railway Exchange Bldg.	
SEATTLE (1)	500 Wall Street	

WHAT'S INSIDE? A BIG PLUS



AUTOMATIC LUBRICATION AND DOUBLE "O" RING SEALS



Smith Fire Hydrants are easy to operate, inexpensive to maintain and most dependable in meeting severe climate and operating conditions. In addition to maximum flow and simplicity of design, Smith Hydrants now have two additional features of major importance: (1) Automatic lubrication — chamber sealed with "O" Rings contains a permanent type lubricant — temperature range–30° to 200° F. Each time the hydrant is operated, the threads and bearing surfaces are automatically lubricated. (2) "O" Ring Seals — the lower "O" Ring seals the internal pressure, the upper "O" Ring is a combined external dirt and moisture seal. This construction eliminates the conventional stuffing box and packing gland adjustments.

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

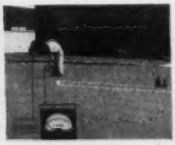
EAST ORANGE, NEW JERSEY

M-Scope "Master" Electronic Witch
Leak Survey Instrument and Pipe Locator

The transistorized "MASTER" Leak Detector—Pipe Finder Combination is the first dual purpose instrument with separate and independent leak detector and pipe finder circuits. Now you can have two instruments in one without any compromise in performance. The "MASTER" Leak Detector—Pipe Finder incorporates the very latest advances in electronic construction and circuitry in addition to having an exceptionally long battery life. An ideal instrument for any Water Department.

Finding a leak under pavement

Locating a leak at the valve



Location of dead ends

Locating a service

Write for information, demonstration or trial.

PIPE LINE EQUIPMENT

JOSEPH G. POLLARD CO., INC.

PIPE LINE EQUIPMENT

PIPE LINE EQUIPMENT

Place your next order with POLLARD

If it's from POLLARD . . . It's the Best in Pipe Line Equipment

NEW HYDE PARK • NEW YORK

Branch Offices: 964 Peoples Gas Building, Chicago, Illinois
333 Candler Building, Atlanta, Georgia

Vol. 74
1960

That's why these "magnetic" meters are the easiest and most economical to repair

It's a fact—the major expense in repairing meters comes from replacing or rebuilding parts that wear out or corrode while operating in water.

There are only two "wet" operating parts in the Rockwell *SEALED REGISTER meters, both in the measuring chamber. *These parts, the piston and piston roller, are the only ones that should ever require replacement.* All other moving parts, including the intermediate, are hermetically sealed in the register casing. Since this sealed construction bars water, dirt and condensation, *no maintenance of the register unit is ever needed.*

With a powerful magnetic drive, effectively shielded to prevent cheating, there is *no stuffing box* to leak, bind, wear or require replacement.

This simple construction means less friction and wear—meters that are much easier and more economical to repair. Write for catalog. Rockwell Manufacturing Company, Dept. 164M, Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ontario.

*Trademark

POWERFUL MAGNETIC DRIVE

Illustrating how the driver magnet (shown in hand) revolves around a watertight compartment at the base of the register to push the follower magnet which in turn drives the register shaft.

SEALED REGISTER METERS

another fine product by

ROCKWELL

Warren Foundry & Pipe Division

of

SHAHMOON INDUSTRIES, INC.

Manufacturers of

CAST IRON PIPE & FITTINGS

Made in Accordance with Latest Specifications

Including TYTON Joints

Either Cement Lined or Tar Coated

Pipe Made in Everett — Centrifugally Cast in Sand Lined Molds in 16′ L/L

Pipe Made in Phillipsburg — Centrifugally Cast in Metal Molds in 18′ L/L

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Tel. Liberty 2-7979
55 Liberty St., New York City
Tel. Worth 4-7993

PLANTS

Everett, Mass.
Phillipsburg, N. J.
Ore Mines — Crushed Stone at
Dover, N. J.

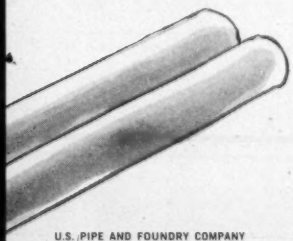
U.S. cast iron PIPE FOR WATER, SEWERAGE AND

almost as easy!

In their enthusiasm our hillbilly pals sometimes exaggerate.

Tyton Joint® pipe isn't quite as easy to install as falling off a log. But almost! One simple accessory and you're in business! No bell holes. No nuts, bolts, pots or ladles. Fewer weather delays, too. Tyton® can be installed in rain or wet trench, if need be. And even inexperienced crews can lay it.

Want more working days, less time, trouble in the trench? Tyton Joint pipe is your answer. Get the facts. Call or write today.



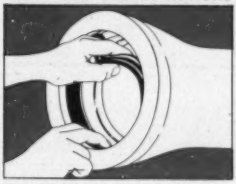
U.S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A Wholly Integrated Producer from Mines and Blast Furnaces to Finished Pipe.

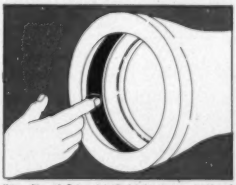
INDUSTRIAL SERVICE CAST IRON®

TYTON®

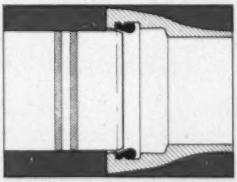
ONLY FOUR SIMPLE ACTIONS



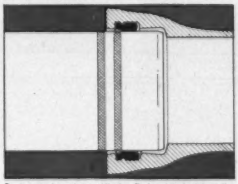
Insert gasket with groove over bead in gasket seat . . . a simple hand operation.



Wipe film of Tyton Joint® lubricant over inside of gasket. Your receiving pipe is ready.



Insert plain end of entering pipe until it touches gasket. Note two painted stripes on end.



Push entering pipe until the first painted stripe disappears and the second stripe is approximately flush with bell face. The joint is sealed . . . bottle-tight, permanently! The job's done . . . fast, efficiently, economically. Could anything be simpler?

"It's an experiment . . . Ev'rybody claims layin' Tyton is as easy as fallin' off a log."

U.S. cast iron PIPE FOR WATER, SEWERAGE AND

almost as easy!

In their enthusiasm our hillbilly pals sometimes exaggerate.

Tyton Joint® pipe isn't quite as easy to install as falling off a log. But almost! One simple accessory and you're in business! No bell holes. No nuts, bolts, pots or ladles. Fewer weather delays, too. Tyton® can be installed in rain or wet trench, if need be. And even inexperienced crews can lay it.

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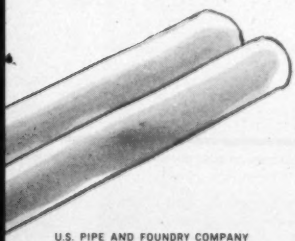


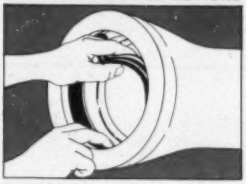
U.S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A Wholly Integrated Producer from Mines and Blast Furnaces to Finished Pipe.

INDUSTRIAL SERVICE CAST IRON

TYTON®

ONLY FOUR SIMPLE ACTIONS



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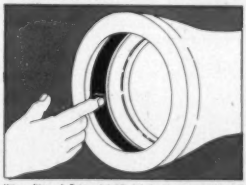

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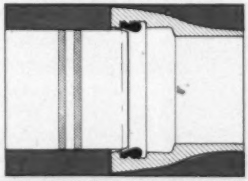
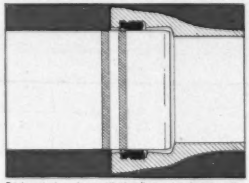


Insert plain end of entering pipe until it touches gasket. Note two painted stripes on end.



Push entering pipe until the first painted stripe disappears and the second stripe is approximately flush with bell face. The joint is sealed . . . bottle-tight, permanently! The job's done . . . . fast, efficiently, economically. Could anything be simpler?

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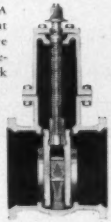

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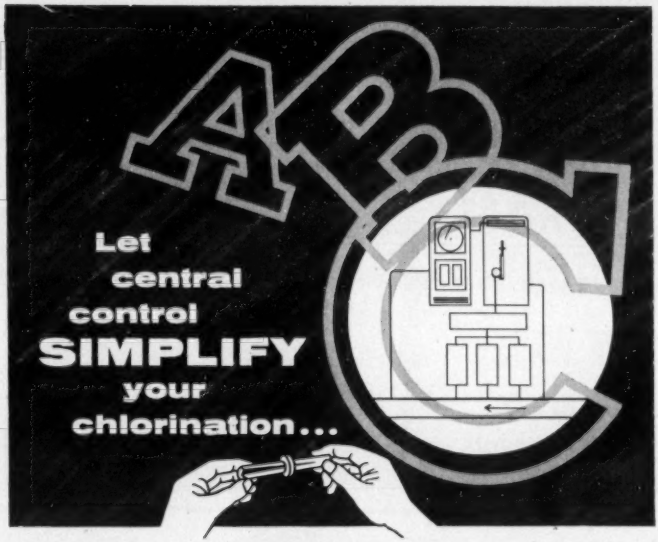

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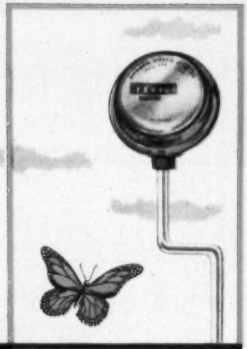

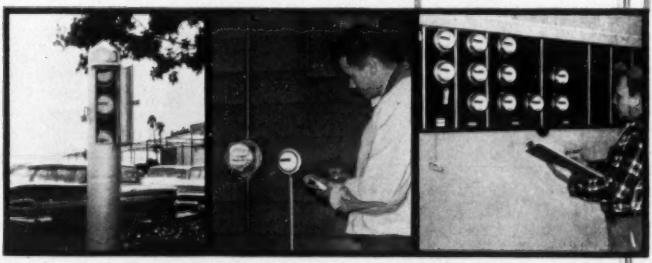

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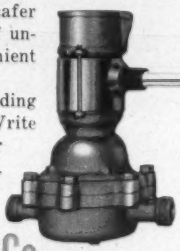

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NEW ENGLAND WATER WORKS ASSOCIATION
ORGANIZED 1882

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This Association, as a body, is not responsible for the statements or opinions of any individual.

PUBLIC WATER-SUPPLY RESOURCES OF THE CONNECTICUT RIVER VALLEY

BY ANGELO IANTOSCA*

[Read May 19, 1960]

The Connecticut River rises in the Connecticut Lakes in northern New Hampshire and flows southward between New Hampshire and Vermont across Massachusetts and Connecticut into Long Island Sound. It is the largest river in New England —about 345 miles long, draining an area of 11,345 square miles. The drainage area located within Massachusetts amounts to some 2,720 square miles. The important tributaries of the river in Massachusetts are the Chicopee, Millers, Westfield and Deerfield Rivers.

The population in Massachusetts located within the watershed as of the Massachusetts Decennial Census of 1955 was 590,829 persons. This represents an increase in 20 years of about 78,000 persons or 15.2% (based on 1935).

The industry in the valley is varied but consists mainly of paper, chemical, textile and machinery.

The main theme of this discussion, however, in consonance with the objective of this association, will concern itself primarily with public water-supply resources. Therefore, perhaps the most important development in the watershed is the Quabbin Reservior supply, which has been described previously in other papers too numerous to mention. This development has resulted in a reservoir with a storage capacity of 419 billion gallons and about 30 miles in length.

In addition to providing the backbone and main source of the M.D.C. system, supplying many communities in the eastern part of the state, three communities of Western Massachusetts in the Connecticut Valley have availed themselves of this source

*Associate Sanitary Engineer, Massachusetts Department of Public Health, Western Mass. Public Health Center, University of Massachusetts, Amherst, Mass.

—namely, Chicopee, South Hadley Fire District No. 1, and the town of Wilbraham. It is interesting to note that other communities in the valley, seeking additional sources, have considered this for augmenting their sources, which apparently are becoming inadequate in meeting their increasing demands.

At the present time there are some 28 community supplies in the valley, 24 of which are publicly operated and 4 by privately owned water companies. The largest and most extensive in Western Massachusetts is that of the city of Springfield, which provides for the water needs of some 200,000 persons. It is interesting to note that on the maximum day in 1959 a total consumption of 51,150,000 gallons was recorded, or 290 gpcd. During the maximum week it was about 220 gpcd. The Springfield Supply, whose main source is Cobble Mountain on the Westfield River watershed, is carefully controlled for bacterial and chemical quality by a trained full-time chemist-bacteriologist. As a result, no chlorination is required, and treatment consists solely of slow sand filtration. The other source of supply which is controlled by the city is derived from the Ludlow system on the Chicopee watershed. This supply is filtered and chlorinated due to water quality and type of watershed involved. It is interesting to note that considerable expansion of water facilities of this community has been taking place over the past decade, involving increases in filter, transmission and storage capacity, the latter phase being concerned with the construction of two 15-million-gallon prestressed concrete tanks on Provin Mountain in the town of Agawam.

The second largest community in the valley, the city of Holyoke, has also taken a major step in water-supply improvements and expansion, represented by the new Tighe-Carmody Reservior with a capacity of 4.8 billion gallons and an estimated safe yield of 13.0 mgd at spillway crest. The second phase of this project, concerning increased transmission-main capacity from this development to the city, to make this yield effective, is now in the late planning stages.

Other municipalities in the valley are experiencing problems of increased consumption and inadequacies of existing waterworks facilities to meet demands involved. As a result of time involved and in most cases the complete use of existing yields

of surface sources, resort to the development of ground-water sources has been made.

Exploration of such sources has been made by many of the communities, and gravel-type wells have been installed in thirteen of them. These represent twenty-one large-yielding wells. Two of the public supplies are entirely from ground-water sources and the balance from a combination of ground and surface sources.

The potential yield of ground-water sources in the valley seems to be quite extensive, depending on location. No significant value, however, has been estimated, since the data required for this have not yet been made available; this would entail more exploration and compilation of existing data than have been carried out to date.

Nevertheless, based on such information, findings and engineering studies as have been made, it would appear that the area with excellent ground water potential appears to be along the Westfield River valley where two communities, Westfield and West Springfield, have developed supplies of relatively large yield. Based on the depth of waterbearing strata encountered and on pumping test data these yields can be increased quite significantly over that provided for by existing pumping facilities. Other areas of excellent ground water potential have been located in Easthampton which has had great success in this regard and the only question which generally has to be determined is where the installation should be placed for optimum benefit as far as distribution is concerned.

Generally speaking, the quality of water from surface sources is quite satisfactory for public water supply and treatment is generally restricted to chlorination. There are, however, seven communities who maintain slow sand filters. Calgon is applied for corrosion control on a regular basis in only one supply with a surface source.

The problem of corrosion and iron in ground water sources of the valley has not been one of concern. Most well supplies are of excellent quality and are pumped directly to use without treatment of any source, and at only one location is soda ash used for corrosion control. One other supply is considering the use of lime in its ground water supply because of its aggressiveness.

With the rate of increase of our so-called "exploding" population new sources of supply will have to be made available. A survey of the valley shows that there are many streams which can be developed and made available. Studies in the past have considered the Millers River as a possible augmentation of the Quabbin Supply in the future. The Westfield River has also been discussed as a possible additional source for Springfield and this matter has come up recently in connection with flood control activities in this watershed.

Although, the use of the Connecticut River for water supply purposes has not been generally discussed, the Department has been quite active in the past few years in pollution abatement activities which is accelerating at a good rate. During the past two years eight communities have undertaken major sewage treatment and disposal works to reduce the pollution of this river. Five of these involve municipal sewage treatment plants now in operation or under construction while five others are completing detailed plans or are ready to begin construction activities in the near future. Cities and towns on the tributaries are also making studies in this regard where the problem of pollution exists and one community has begun construction of a sewage treatment plant.

Such activities are necessary in order that the quality of our water resources may not be further impaired for possible future public use as well as to make them available presently for industrial, recreational and irrigation purposes in order to maintain a healthy population and prosperous economy.

TWENTY-FIVE YEARS OF WATER FILTRATION PROGRESS

BY KENNETH F. KNOWLTON*

[*Read June 16, 1960.*]

The Salem and Beverly Water Supply Board, created by an act of the legislature in 1913, has been in the water filtration business since December 1935, when its filtration plant was placed in operation. This marks the twenty-fifth year of operation for these works. During these 25 years the process has grown from one treating six million gallons of water per day to one treating 8.4 million gallons per day. The maximum day 25 years ago was about 9½ mil. gal. The maximum day at the present time runs to 16 million gallons. Capital investment in entire plant, including watershed, Ipswich River diversion works, etc., at about the time of completion of the filtration plant was approximately $600,000. Actually there was more money than this invested, since the filtration plant was built as a Federal ERA project and labor charges amounting to $303,149 were met by Federal Grants and do not show on the regular Water Board books. Today the total capital investment is about $3,000,000, an increase of $2,400,000.

With this investment of funds and the increase in the amount of water treated we have gained some experience. What have we learned? Certainly some constructive knowledge should have accrued. Table 1 is a list of tabular data showing water consumption, chemical use, and other data over the 25-year period. Water consumption from line 1 is from the records of two high-lift pump stations, while the "water treated" figures are from filtration-plant data. Exact correlation is not to be expected under these circumstances, but we usually show within 2% at these metering points. Table 2 gives a summary of plant operation data for the past six years.

In order to retain some semblance of order in this talk, it is deemed advisable to start with the sources of water supply and

*Superintendent and Chemist, Salem and Beverly Water Supply Board, Beverly, Mass.

TABLE 1—SALEM AND BEVERLY WATER SUPPLY BOARD—COMPARATIVE DATA

			1936	1959
1.	Water Consumption			
	Average day		5.9 mgd	8.4 mgd
	Max. month, daily average		6.6	10.1
	Max. day			15.8
2.	Chemicals	Cost per ton		pounds per mil. gal
		1936 1960	1936	1959
	Alum	$26.93 $38.30	210	198
	Lime	11.65 24.00	87	68
	Carbon	98.01 168.60	27	29
	Chlorine	148.50 146.00	3.9	10.3
	Ammonia	310.00 ———	1.3	none
	Soda Ash	27.92 ———	167	none
	Sodium Hexametaphosphate	— 268.60	none	7.8
	Sodium Silicofluoride	— 126.00	none	11.9
	Total Chemicals $ per mil gal.	——— ———	$5.20	$7.80
3.	Electric Power, total KWH/mil gal		227	247
4.	Filter Plant Operation			
	Water treated, mgd		5.95	8.22
	Filter Runs—Average hours		15.3	19.5
	Percent wash water		4.6	4.0
	Color			
	Raw water		42	55
	Settled water		18	29
	Finished water		8	7
5.	Total cost of filtration plant, 1934-35 (Includes cost to cities and to Federal ERA project)		$654,149	
6.	Fund acct. total (Cost of Capital Investment)			
	Jan. 1, 1936	$584,927		
	Jan. 1, 1960	$3,016,798		
	Of this increase the books show $87,452 was spent on treatment works.			
	1955-1959, inclusive, $36,026 of operating funds was spent on treatment works as "Equipment and New Work."			

TABLE 2—SUMMARY OF PLANT OPERATION DATA

Year	1 Average plant output (m.g.d.)	2 Plant output max. day (mil. gal.)	3 Color (average) raw	4 Color (average) finished	5 Alum average lbs./mil. gal.	6 Total operating cost	7 New equipment (included in column 6)	8 Cost per million gal
1954	7.387	13.090	54	9	242	$107,596	$5,026	$40
1955	7.679	12.780	51	8	206	115,749	9,173	41
1956	7.771	12.350	42	8	170	107,621	6,236	38
1957	8.027	13.793	39	7	188	128,876	14,731	44
1958	7.264	12.327	46	6	182	126,711	3,430*	48
1959	7.893	16.380	55	7	198	131,284	2,455*	46

Note—Capital expenditures except for those in connection with Putnamville Reservoir project:
1958 $26,708 1959 $59,744

**These amounts are not included in column 6 above.*

follow through to the final product and see what problems we have had, what we have learned, what we have accomplished in these various areas.

The original publicly owned supply dates to 1869 when the City of Salem went to Wenham Lake for Water. This lake is still the primary supply. This is a glacial lake which for years has had a very small dam raising the natural level about 18 to 24 inches. This dam has recently been repaired and the old stop logs have been replaced with concrete. Youngsters had gotten the habit of removing the logs on Friday nights and letting a flood down through an adjacent golf course, much to the mutual embarrassment of ourselves and the owners of the course.

It has been customary, even before filtration, to apply copper sulphate to this lake for the control of algae. Our system has worked very well and has been retained. We use a sturdy scow, about 18 ft. long by 4 ft. beam, run by a 10 HP outboard motor. The scow and motor are new replacements of old, slightly smaller units. It will easily carry one ton of copper sulphate in its central bin. Two men with this boat can apply two to two and one-half tons of copper sulphate in one working day, although in cold weather this day might be ten to twelve hours long. Nevertheless, they accomplish it with relative ease. The distribution boxes which we use were built by plant personnel 25 years ago. They are patterned after those described by Cox (See "Laboratory Control of Water Purification," by Charles R. Cox, Case-Shepperd-Mann Publishing Co., 1946, p. 56) and have given complete satisfaction on our reservoir, which has very little shallow area.

The next source of supply is Longham Basin, a small reservoir formed by an earth dam to divert the Longham Brook drainage area into Wenham Lake. This watershed area is now being built upon quite extensively. It covers a very large part of the Centerville section of Beverly which is becoming more highly populated and is not sewered. Much attention is currently being given to proper location and construction of septic tank installations in this area. It might seem that this small reservoir could readily be abandoned to other economic development. However, when we look at the records, we find that in a normal

year we obtain as much as 40% of the water we use from this watershed. Since the construction costs were all paid for years and years ago, this gives what we refer to as "free water." This water is available without cost for pumping. Some watershed maintenance and the taxes paid to the City of Beverly and the Town of Wenham are the only costs.

The third supply of water is drawn from the Ipswich River, which was tapped shortly after the founding of the Water Supply Board in 1913. With 100 square miles of watershed area on this somewhat sluggish river above the point of diversion there is a heavy runoff each winter and spring. There has been no really significant development along the river as yet. Residential areas are expanding, whereas it formerly was farm land. There are no troublesome industrial wastes. A perusal of the records over the years seems to show that there is no significant change in the water quality, either physically or bacteriologically. However, we do maintain an interest in upstream developments. There is extensive swamp area, and if this were drained, it would significantly change the flow pattern of the river and might seriously affect our pumping operations. It could also have considerable effect upon the quality of the water.

Augmenting this supply is the new Putnamville Reservoir which went into operation in 1955. This is a storage basin in the watershed of the Ipswich River but not on the river. Formed by a series of dams and dikes it was constructed at a cost of approximately $2,225,000. This accounts for most of the increase in the capital investment during the past 25 years. Storage capacity of this reservior is 1,700 mil. gallons, which almost doubles the former total storage capacity available. We allow fishing from shore or rowboat in this reservoir, but prohibit use of motors and, of course, we do not allow bathing. Trees have been planted extensively on the watershed.

We have not found it necessary to control the algae in this reservoir. Since the water from the Ipswich River is pumped to Putnamville and then from Putnamville it flows down to Wenham Lake, we do not require too strict algae control. So far we have not had an algae bloom which gave obnoxious odors in the area. Of course, if this condition should prevail we would go in with copper sulphate and treat the water.

In conjunction with the Putnamville Reservoir a 36 inch diameter pipe line was constructed between the existing pumping station at the Ipswich River Canal and Putnamville Reservoir. This pipeline is used in both directions with by-passes around the pump. We also installed a new 450 horsepower electric driven pump in this station. For controlling the flow we chose butterfly valves. The valves would be in pits outside the station and the original proposal for gate valves with electric operators was abandoned because the operator would be exposed above ground. We were afraid some misbegotten person would use it for target practice! The valve which controls the gravity flow from the reservoir to Wenham Lake is a 24-inch rubber-lined butterfly valve with an oil hydraulic accumulator system. There was no pressure water available in this station. This valve has worked with complete satisfaction since it was installed. Another isolating valve in the line is a 24″ manually operated butterfly valve. This valve was in a pit which could not be drained, and consequently was continuously under water. After about two years the hand wheel could be turned only with great difficulty. Corrosion had caused the steel shaft to seize in the iron worm gear case. We disassembled the operator and inserted a bronze bushing in the case where the shaft emerged. There has been no further trouble. I understand that this type of construction is now standard practice with the manufacturer.

This pumping station also has a telemeter system signalling over a leased telephone line to the filtration plant where a recorder shows the rate of flow of water through the pipeline between Putnamville Reservoir and the pumping station. This flow is recorded both when pumping to the reservoir from the river, and when flowing by gravity from the reservoir to Wenham Lake. An auxilliary pen indicates the direction of flow, and separate totalizers complete the record.

An intake structure originally built by the City of Salem in 30 ft. of water has been taken over by the Water Board. There are two openings in this structure—at 10 ft. and 25 ft. below high water in the lake. Removable bronze mesh screens with ¼″ openings keep fish from entering the pumps—most fish, that is. We get a few fingerlings, and every so often a heavy run of small eels. There was one period when we had to shovel little eels off the sand in the filters.

A 30-inch-diameter suction line leads to the low-lift pumping station. Dresser bell clamps have been installed on all joints in this line, wherever it is above water. We installed two in Dec. several years ago when the lake was drawn down very low and joints were exposed which had never before been out of water. It was a cold wet job, but it stopped the leakage of air at a time when we had a fifteen foot lift from the lake level to the pumps. This intake tower and suction line is adequate, but it constitutes a weak link, since it is now the only place, except in the filtration plant, where we rely on a single pipe line for both cities. The fire underwriters have advised an auxiliary intake for emergency use, but so far there have been other deficiencies of a more serious nature. In the meantime thought is being given to the project and doubtless it will be undertaken in the not too distant future.

The low lift pumping station is located near the intake on the lake shore, and is about 1000 feet from the filtration plant. This station originally contained three pumps, driven by 50, 75, and 100-HP, 4000-volt synchronous motors, remotely controlled from the filtration plant. These motors were apparently installed to help the power company at a time when we were out on the end of a circuit. An attractive discount for maintaining a favorable power factor made this arrangement desirable. Now that we are in the midst of a network, it is doubtful whether this type of motor would be used. The one new one we have installed is a 440 volt squirrel-cage type. All the electric power for the plant is purchased through one meter located in the low lift pumping station. This arrangement, with a 4000-volt incoming line and our own transformers and transmission lines to the filtration plant, enables us to enjoy a significant transformer discount on the power bills.

The first bottleneck which we hit following the procurement of an adequate supply of water came in the capacity of the low lift pumping station. About four years ago, when we no longer restricted summer water use, there was a period when on some days we had to operate all three pumps around the clock to meet demands. With the electrical gear all twenty years old, and no spare, it can be understood that there were a few uncomfortable moments. Nevertheless, we had just completed 2¼ million

dollars worth of water supply reservoir and felt the people were entitled to every drop we could deliver. Besides, it went through their meters and so helped pay the bills. If a pump failed, time enough then to put on restrictions.

Something obviously had to be done that winter. We started looking at the smallest pump, dug out of the curves, and found that this pump had an undersized impeller. A new full size impeller in the original case would give roughly one million gallons a day more water, and at a higher head (1). This made an easy start. We didn't have to change any piping. We looked at the 50-HP motor. The new impeller would require 75 HP. We dug out the motor prints and found that the 75-HP motor sitting beside it had an identical frame. Maybe all we needed was new "innards" for the motor. A telephone call to the motor manufacturer brought forth the following: "Thunder, that motor was built for 50 HP at 80% power factor. Run it at unity power factor and it will give you 75 HP." The insurance company was a little skeptical, probably because they were now becoming rather insistent that the motors be rewound if they were to be insured any longer. We made a concession and had the motor rewound with a high-temperature insulation and the motor manufacturer made a new name plate listing the motor as a 75-HP unit. Thus, for a very small expenditure and about one month with the motor out of service, we were on our way and had enough water for the following summer. Immediately plans were laid for the next winter's work. Careful studies were made and then a new pump and motor was ordered to go into the fourth place, a place which had been left for such use in the original design. This unit ended up by being almost a duplicate of the old small unit, even to the undersized impeller. It is powered by a 75-HP motor, although at present it only requires 50 HP. The additional cost of the motor was only about $150 and the efficiency of the larger motor at 75% load was greater than that of the smaller motor at 100% load. Again, when the need arises a new impeller will come to the rescue.

When this pump was installed a stub was left and blanked off in the suction header so that a new intake from the lake could be easily connected.

Installation of this pump was also tied in with the next

project which was needed—a new pipeline from the pumping station to the filtration plant. The piping from the pump was extended out to a new valve chamber which would be the starting point for the new pipe line. The valves to control the flow in either or both of the pipe lines were 24″ rubber-seated butterfly valves, installed in pits beneath the driveway outside the pump station. These valves were equipped with hydraulic cylinders, which in turn were controlled by small four-way valves located in the pumping station. Every month or so, during his routine maintenance, the mechanic opens and closes these valves to keep them in condition. These valves will enable us to isolate the pumps by twos very easily. We never were able to get the old gate valves to close tightly, so we left out the discharge valve on the new pump, using only a check valve and the new valve out on the line. In our experience we have had almost no trouble with check valves, and very much trouble with gate valves.

After installation of the pump and valve chambers, we started the pipe line job. Where we now had adequate water through the low lift station, we would now have it to the inlet of the filtration plant. This line, of prestressed concrete cylinder pipe was installed from January to March of 1959. The late start was to utilize the period of low water in Wenham lake for the deep excavation needed in much of the work. This way the entire job was carried out in the dry. We also feel we got a good price for several reasons. The job was very well engineered, it was to be done in the off season, and there was plenty of time available in case the weather turned bad. The line was in operation on June 1 which date had been set as the time for completion.

Installation of this line will enable us to take the old line out of service for cleaning. Its "C" value has dropped to about 70 in twenty-five years, apparently from slime growths on the inside. The sections we removed showed the old Bitumastic coating to be intact beneath a thick layer of stiff, black ooze.

The design of the pipe line led us into the back door of new plant processes. The new pipe line would require a new meter, and we might just as well let it do the things a modern meter can do.

In the first place we chose a stainless steel orifice plate as the primary element. This cost about $200 as contrasted with approximately $2000 for a venturi tube. With this decision we let the pipe-line contract, and then began to design metering. It grew as our ideas clarified. We talked with every meter and instrument man who came near the plant and laid out the tasks which were to be performed.

Gradually we crystallized the system and came up with the control panel board shown in Figure 1. This has many functions, which can be most easily followed by reading from left to right. Top left is the Fluoride recorder-controller, which has been previously described (2) (3). Next is the level recorder and alarm for the clear well. These instruments and some others had been located elsewhere in the plant. The next two instruments are the flow meters on each of the two pipe lines. They record water flow in red ink. They also are flow meters for the liquid alum being fed to the two pipe lines. This is recorded in violet ink (4) (5). A ratio controller in each instrument controls the alum valve and applies alum to the water at a rate proportional to water flow. A simple finger-tip adjustment enables the immediate changing of the dose when necessary. The next two instruments are pH meters. Bottom row left is the telemeter from the Ipswich River Canal pumping station with its extra totalizer mounted above. Second left is a meter which shows the total flow of water through the plant, being an instrument which totalizes the flow in each of the raw-water lines. This instrument is also a controller. A time impulse unit in the case is used to control three new dry-feed machines just placed in operation. A vacuum controller is used to control a new chlorinator, placed in operation yesterday, and its twin to go in tomorrow. In the center are pressure gauges and push buttons, while the wash-water meter and a recording thermometer for water entering the plant take up the right-hand spaces.

For all of the new meters we selected seven-day circular charts. The value of visual recording lies in the completeness of the story that is told, and with these charts several days of operation can be observed at a glance and variations quickly noted. Strip charts show only a very few hours unless the chart

FIG. 1—Main Control Panel for Water Filtration Plant Installed at Salem and Beverly Water Supply Board, North Beverly Massachusetts. Instruments shown are: top row, left-to-right: Dynalog conductivity fluoride controller; clear-well level recorder; M/40 ratio controller for liquid alum line #1; same for line #2; M-H pH indicating recorders for lines #1 and #2. Bottom row, left-to-right: Teletax indicating receiver recorder for reservoir total flow; flow recorder for filter plant; indicators for plant air pressure, service water pressure, Beverly water pressure and Salem water pressure; flow recorder for wash water; temperature recorder for water. (*The Foxboro Co.*)

is unrolled. Daily charts accumulate too fast for me, and I do not feel that we have to read the minutes that closely.

Now that we have gotten inside the treatment plant, let us take a look at the process. Liquid alum is used for the coagulation of the color in the raw water. We have tried various coagulant aids with mediocre success in the laboratory. It appears that the effectiveness of these aids is less with color removal than with the removal of turbidity. So far, we have been able to get good results with alum alone, but the day may well be close at hand when other materials will be used instead of, or in conjunction with, the alum. We make an attempt to perform at least brief laboratory tests with all of the easily available materials.

We have made one very interesting observation in regard to coagulation of our water by alum. As our plant loads began to increase a few years ago, we began to experience difficulty in obtaining good results in the winter. Plant operation would not follow jar tests, and alum doses were sometimes as much as double those indicated by jar tests, whereas in the warm months correlation between plant and laboratory tests was almost perfect. Soon we began to observe that samples collected on the distribution system would show a precipitate, which was apparently alum floc. This suspicion was heightened when the color of the water leaving the plant was 10 and that at some points on the distribution system was only 5. The same water leaving the plant at 10 could be reduced to 5 when passed through a paper filter. At this time we were almost frantically working with various filter aids, looking for a good answer to the problem. We were also just starting the use of liquid alum and had procured a pH recorder and controller, which was being used at the time to control the alum dose. Inadvertently the alum dose got left one time at an amount just equal to that indicated as a minimum by the jar tests. It ran at this dose for 24 hours before it was noticed, and it was also then noticed that the water leaving the plant had a color of about 10 and that this color would also pass a paper filter. There was no after-precipitation. Henceforth during the cold weather we have been careful to hold the alum dose at a very minimum. Apparently the higher doses leave some residual alum or coagulated

color, which works through the filters and then may precipitate in the distribution system. This system has worked now for three or four years and has greatly reduced our alum consumption. We got a reminder of it this past winter. A local manufacturing plant has a small deionizer, which is preceded by a paper filter. This past winter the filters began to plug very rapidly. We had been preoccupied with other matters and had not been so careful in cutting back the alum dose. We reduced our alum dose rather sharply to a minimum, and the filters at the manufacturing plant immediately began to operate in a normal manner. Moral:—when in difficulty try the easy way out as well as the hard way out!

Activated charcoal has always been used at the plant, as needed, for the control of tastes and odors. In fact, the plant was built as much for taste and odor control as for color removal. New Englanders live in an area where communties with surface-water supplies are adjacent to communities with ground-water supplies which have no taste or odor. Consequently I feel that we are more prone to get complaints of tastes or odors in our surface-water supplies. We have had complaints on a broad basis when the threshold odor was only 1.5, and this indicates that the problem is somewhat different from those places which reduce odors from 100 or so to 10 or 14. They are doing a good job, but it would not be good enough for us. Our maximum is seldom 10. Our most troublesome tastes usually occur in the fall and are not apparently connected with algae growth, but with the overturn. Frequently they are very obnoxious to certain people, while others can barely detect them. In all cases, if enough carbon is used, the odors can be controlled. There have been times when we could not feed enough carbon, but that has been remedied with the installation of new dry feeders this spring. None of the doses we have used have been high, as doses go in places where they have real odor problems. It comes down to balancing the cost of treatment against whether we should serve good water or excellent water.

Corrosion control has been effected for many years now with the use of sodium hexametaphosphate, with apparently rather good results. We have tried to maintain a residual of 0.5 mg/l in the far ends of the system. I am now feeling the

urge to increase this somewhat. There has apparently been much less red water and tuberculation trouble since we changed to this system, following a period of pH adjustment to about 8.6. We now adjust the pH to 6.8 or 7.0, partly to deliver a water of constant quality, and partly because we found red water problems starting when the pH dropped to about 6.0.

Our fluoride control has been described in a previous paper. In order to make the control system work, we had to move the point of lime addition from beyond the filters to ahead of the filters. We thought that this might tend to disperse some of the color, but this did not happen, at least with the pH which we use. For a time we got high color out of one filter and finally traced it to the fact that the lime was not being thoroughly dispersed in the pipe line before reaching this filter. The pH on this filter ran up to about 8.0 while the average was 7.0, and the color was passing through this filter. The cure was a relocation of the lime-injection point.

This describes the bulk of our problems with chemical feed. Mechanically we had relatively little trouble. The original dry feeders and the original chlorinator were in service up to this spring, when they were replaced with new and much larger units. We had outgrown the capacity of the old machines. The new ones are all on automatic control, as explained earlier.

The first step in the treatment is the mixing of alum and other chemicals with the water. Our plant has mixing basins with a 15-min capacity at 8 mgd. At some of our new high loadings this is reduced to nearer 5 to 6 minutes. It has been necessary at times of peak flow to run the basins in parallel with every gate open, in order to reduce the head loss to a minimum. We are now reaching the actual hydraulic capacity of the units.

Sedimentation is in the old standard type of basins. Ours are around-the-end baffle type, designed for four hours' detention at 8 mgd. At 16 mgd the detention is down to two hours. There are no flocculators, and the effluent weirs are very short and have a high velocity. In spite of this we still get what we think are good results. However, there is much room for improvement here, and design is now under way for flocculation equipment and modern effluent weirs. It is hoped that this equipment will be contracted for before the end of this year.

This is a project which we felt four years ago would be the most necessary in increasing plant capacity, but as it has worked out it is just about the last of the improvements to be made in the existing plant.

We have carried out a great deal of filter rehabilitation work over the years. The original filter design consisted of perforated cast-iron underdrains with 18″ of stone, starting with 2½″ size and grading down to very fine. On top of this there was placed 30″ of sand of .35 mm effective size. There was trouble with shifting gravel layers rather early in the operation. At the time I took over operation all of the filters had been restratified once and were in need of a repeat operation. After several attempts at rebuilding the filters showed that we could not make them hold up in accordance with the original design, we departed to another design. One filter was rebuilt with porous plate bottoms, eliminating all of the gravel. There was a 30″ layer of 0.50-0.55 mm sand placed in the filter, and it gave excellent results. When this filter was originally dismantled it was found that the cast-iron underdrain pipes were in poor shape with the holes completely plugged up in large areas, and in other areas the holes were eroded to large sizes. Thus an even backwash could not be expected.

The following winter a second filter was dismantled. Enough good cast-iron pipes were salvaged from this and the filter of the previous year to construct a new bottom with the cast-iron underdrains. The holes were reamed to uniform size, and the pipes dipped twice in Bitumastic solution for protection. This time we started with ¾″ gravel as the largest size, using fewer layers, but each thicker than the original, to get our 18″ supporting layer of gravel. Again we went to the coarse sand. This filter has given excellent service, and the gravel appears to remain in place.

However, our experience with these two jobs showed that we could rebuild a filter much more easily with the porous plates, and consequently the rest of our filters have been done this way. All eight filters have now been rebuilt and filled with the coarser sand. Seven have porous-plate bottoms, the oldest having been in service for about seven years without trouble. We developed

a technique for our filters which enabled us to rebuild the final three filters during one winter.

Our experience with these bottoms has shown that they will last as long as, or longer than, the original type, and if they should plug up, they can be replaced or cleaned very easily compared to the old gravel bottoms. There is little or no evidence yet of the plates tending to plug up.

One year ago we removed the sand from one of the filters and refilled it with No. 1 Anthrafilt, which is an anthracite coal filter medium with an effective size of about 0.70 mm. We wanted to try the effect of a coarser medium in the filters, and this seemed to offer the best solution since it would wash at just about the same rate as the sand in the other filters. We have not had a chance to make good comparisons, but this filter appears to give as good an effluent as the sand filters. It probably would give somewhat longer runs, but out of habit it gets washed roughly on the same cycle as the sand filters. It will get more serious study in the future, when we try to get the utmost yield from each filter.

With plenty of water coming to the filtration plant, and equipment of adequate size to apply the proper chemical doses, we were left now at the point where the filter rate controllers were the most serious bottleneck. These were old manual controllers, which became obsolete a few years after they were installed. When more water was called for, it was necessary to go into the pipe gallery and adjust each controller by hand. Being called out late at night to perform this operation was not a pleasant activity.

We were prepared to order butterfly valves and control mechanisms which would give us automatic filter control, when one of those unexpected things happened in the nick of time. Thumbing through one of the trade journals, I don't recall which one, I came across a short paragraph mentioning declining rate filtration, referring to work done by Hudson (6). This concept was not new to me, but this short notice at the proper time was what it took to focus my thoughts on a new design. We ended up by procuring one 30″ rubber-seated butterfly valve with a pneumatic cylinder operator and installing it in the filter-effluent manifold just ahead of the clear well. This valve was controlled

from a level controller taking its signal from the level of the water in the filter-influent manifold pipe. Thus, when we put in a larger pump, the water tends to rise at the filter influent, the large effluent valve opens slightly and the filter level remains constant. If we shut off one filter, the level on the others rises, the valve opens more and the filters divide the extra load.

With this arrangement, the old rate controllers are set for the maximum flow which is to be allowed on the filter. In our case they are wide open in the summer. A clean filter operates at this maximum flow, which may be 4 or 5 gallons per sq. ft. per minute, but as the head loss builds up, the flow rate declines. In our plant we usually wash when the rate is down to about 2 gals./sq ft/min, but might wash sooner at times when we need every possible gallon of water. The suitability of the declining rate, in itself, is not surprising to us, because that is just what has been happening for two or three summers when we operated with the filter controls wide open. The only difference is that we are not forever turning filters on and off to maintain a level. This installation cost us about $2,300, as compared to a cost of $1,000 to $1,500 for each filter if separate controllers were to be put on the filters.

Our operating experience with this piece of equipment has been perfect to date. We worked around the clock to get it installed, and at 6 A. M. it was ready to go. We turned it on, made one rough adjustment and went home to bed. There has not been a total of more than ½ hour spent on it since.

With the high loadings we are now giving our filters the mud-ball problem is becoming more severe. We scrape off the top layer of sand two or three times a year as small mud balls accumulate. This prevents them from becoming large enough to penetrate the sand and form layers in the filter bottoms. To give what we hope will be permanent protection from the formation of mud in the filters, we are installing rotary surface-wash equipment this year. The bids have been opened and the equipment has been ordered. Installation will be made by the plant personnel. Lacking a source of high-pressure filtered water to operate these units, we are planning to operate them with settled water. There is a pipe line accessible at this part of the plant where a booster pump can be easily installed.

Sodium hexametaphosphate is added immediately following the filters, and this is followed by the addition of sodium silicofluoride. The water then passes through the new filter control valve just described, through about 50 ft. of pipe and into the clear-water reservoir. A plastic pipe is inserted into the pipe line immediately at the reservoir inlet and brought back to a sample pump in the plant. This gives us a continuous running sample of the water as it leaves the treatment process. In a new plant design some provision should be made for good samples of the very final effluent. Our sample line is threaded through a series of sleeves as an afterthought and is prone to become air-bound. If automatic controls are to be operated from this sample line it must be very carefully designed.

Our clear-water reservoir is outside of the plant, is covered, and has a capacity of four million gallons of water. It is very large and worth every penny that it cost. When the plant was built it was to supply two existing high-lift pumping stations, which operated at high rates for about 8 hr. a day. A filtration plant which would supply the water for a day in eight hours was too expensive, so the large reservoir was built. This has enabled us to operate at rather constant rates throughout the day. It gives us enough storage so we can shut down for several hours to perform maintenance or construction tasks, which would otherwise be very difficult. When you can shut down your plant for 12 hr or so, drain a section of pipe, install a large valve in the dry and start up again without having any effect on the supply of water to the consumer, many things can be accomplished with a small force and a limited budget. Had we not been able to make these shutdowns, I hate to think what the cost of some of our projects would have been.

This large reservoir is wonderful, but there are two things which should be done in a similar future design. No provision was made for draining this reservoir. Another is related in a way to it. The inlet pipe from the filters enters at the same sump where the suction pipe for the wash-water pumps leaves the reservoir. Over the years there was enough sand leakage to give a buildup in this sump. The sand is then picked up by the wash-water pumps and forced back into the underdrain system. So far we have not been able to remove this sand with pumps or

ejectors, and draining the reservoir so that it can be cleaned has been too difficult to attempt to date. Soon it must be done, however. Our new filters have eliminated the addition of new sand to this storehouse, but that already deposited still goes on its merry rounds. Enough worked up under one of the porous-plate bottoms to plug a significant section. As soon as it was noticed, a couple of plates were lifted out of the filter, and a hose quickly flushed the sand down the drain again. Where will it show up next? The outlets from the reservoir to the high-lift pumping stations are diagonally across a distance of 250 ft. There should be no danger of getting sand into the high-lift pumps.

Another look at Table 1, especially section 4, shows what has been happening over the years. We have greatly increased the amount of water treated, and at the same time the filter runs have increased, the wash water has decreased, and the finished water actually shows a slight improvement. It would be easy if we could say this had been a mistreated plant, and proper operation had restored it. However, this is not so. The original design was generally excellent. The first operator was Robert Johnson, then and now a member of this Association and a well qualified sanitary engineer. Ellis Tarlton, likewise a trained professional sanitary engineer with experience, and a member of this Association, followed Mr. Johnson. I have been in charge since Mr. Tarlton left in 1941. It appears that whenever we try to get more water through the plant by taking some liberties with older design and operation concepts, we get as good or better results than we had formerly.

High-lift pumping and distribution of the water to the consumers was left as a responsibility of the individual cities when the Water Board was created. This, of course, lessens our work. We assist the two cities by making analyses of the water in the distribution system and by answering complaints where water quality is involved. They assist us around the plant by loaning equipment and helping us with certain mechanical jobs for which they have trained men.

Each week we collect eighteen samples of water on the distribution system. These samples extend from the populated centers out to the extremes in both Salem and Beverly. The

bacteriological results are used to certify the water in accordance with the United States Public Health Service standards for common carriers, while the pH, color, and fluoride determinations serve as the final check on our chemical control. We do not have too much trouble with red water or copper staining, but both are present in certain places or at certain times. An extensive flushing program was carried out in Salem this past year and has greatly improved conditions there. Some of these old mains date back to 1869 and probably had never been thoroughly flushed before.

Over the past quarter-century we have pumped a lot of water, but we have let as little as possible go over the dam. We have tried to use it. In the light of this experience I should like to mention a few things which I would change in making a design today.

Today we probably would not use the rather large mixing basins, but would use flash mixers of some sort. An attempt would be made to arrange units and piping so chemicals could be added at a maximum number of locations. Many of these could not be predetermined, but there should be access so that new taps could be easily installed.

Probably akin to the above comment would be one concerning electric wiring. Ours was quite liberal in concept for the time, but it is in the concrete. Additions and changes are difficult. Wiring should be in trough or conduit so it can be easily changed.

I am very happy with the porous-plate filter botoms. From the operator's point of view, the elimination of any gravel is one of the greatest things to happen in filtration practice.

Modern filters are built larger, and in pairs so that many valves can be eliminated. This is good. Also I like the filter-rate control system that we have. In a new job, I would give consideration to installing a butterfly valve on each filter as an isolating valve, and having this valve calibrated so that it could be left open or partly closed during different seasons of the year. Thus, during the low-demand months of winter, the maximum filter rates could be kept lower.

Unfortunately, it seems that somewhere in every construction project there comes a place where quality must be sacrificed

to dollars. In our plant this was done in the selection of the original valves. These were all standard 50-pound test gate valves with hydraulic operators. There were no square-bottom valves, no supports for discs, or any other special concession for prevention of wear. These valves were installed vertically, horizontally, and on their sides and backsides. Now, 50 p.s.i. is way above anything these valves have to hold, but they just did not have the bulk of metal to withstand the corrosion of coagulated water and the wear encountered when they were operated at least once a day. All of the discs have been renewed at various times, and this past winter the discs of one valve wore right through the side of the valve body! If the gate valves are to be used, make sure they are heavy and are bronze-fitted at points of wear. So far I like the butterfly valves.

There should be some way of cleaning the clear well, either a two-compartment well, or an auxiliary small well, sufficient to get by with for a short period of time.

Valve vaults and manholes should be adequate in size. I have protested as hard as anyone about what I thought were oversized vaults when they were designed by someone else, only to be faced later with the almost impossible task of inserting a large corporation cock into the side of a pipe as it passed through the edge of a little manhole. Later, when I had to design some valve vaults, I realized that an adequate one costs no more than one which is inadequate. The problems of using the vault afterwards are as nothing compared to the problems of erecting and knocking down forms in a small vault with a couple of pipes in the way.

One of my heartiest gripes is the lack of anything from which to hang a chain fall when repairing one of those worn-out valves. In the building structure there should be some means of lifting valves, motors, pumps and other heavy equipment. Monorails are wonderful, but a few well-placed eye bolts would be very welcome.

A modern plant should have an operators' locker room with shower. It should also have a ladies' toilet, since we do want guests to visit the plant. And of course there should be an attractive place for a visitor to sample the final product of the

filtration process. It took us thirteen years to get a good drinking fountain installed!

All floors in a filter plant or pumping station should have a definite slope to some drain point. Water is always being spilled, and a level floor just cannot be dried up properly.

Complaints come with ease, while compliments are sometimes more difficult to muster. There are many very fine features in our original filter plant. If there were not, we could not have done the things we have. The plant's best feature, from my point of view as an operator, is its compact design. Every part of the plant is readily accessible from the central lobby.

Many parts of the plant were left so that expansion would be easy. Sleeves in the pumping station walls, full-size piping throughout the pipe gallery, and a spare electric conduit from the pumping station to the filter plant are examples.

Mention has been made earlier about some fortunate characteristics of the original pump choice. These pumps were carefully selected in the first place and still give efficiencies which are hard to beat today. They were first-quality units and have shown it. New bearings were installed after twenty or twenty-two years, not because they were needed, but as preventive maintenance.

The buildings themselves were of the best construction. The structure is mostly steel beams, encased in concrete. There is very little exposed steel which requires maintenance. The concrete is of superior quality—which we realize every time we have to cut a hole through it! Modern building methods can cut costs, but in a plant of this type an eye should also be kept open and focused upon the future maintenance problems. If the plant personnel does not have to keep repairing the buildings, they have time to concentrate upon better operation of the treatment processes.

This has turned out to be a good plant. We have achieved good operation and hydraulic capacity. The original designers, Metcalf and Eddy, are to be congratulated, as are also the present and past members of the Salem and Beverly Water Supply Board.

There is one further point. In designing a new plant I think I would make the hydraulic capacity of the filters as

great as 10 gallons per sq. ft. per min. During the next twenty years we may be able to achieve this rate.

One feature of the plant design caused a little controversy, I am told. In the lobby there is a tiled fountain and goldfish pool. Its cost, I believe, was some $300 when built, and there were those who thought it too expensive a gimmick. But it has paid for itself time and again. When you get sick of working, you take a couple of minutes to watch the fish and relax. You talk with salesmen and visitors in front of the pool. When the blood begins to get hot, it is just the thing to bring you back on an even keel. And all of the youngsters who have grown up for blocks around have spent hours lying on the floor, watching the fish. This gets them into the plant. They become surprisingly familiar with the treatment process, and we are helping to raise a generation of men and women who appreciate good water treatment.

BIBLIOGRAPHY

1. KENNETH F. KNOWLTON, "Adding a Factor of Safety to Water Pumping Capacities," *Water Works Engineering*, Vol. 111, No. 7, July, 1958.
2. KENNETH F. KNOWLTON, "Investigation of the Continuous Recording of Fluoride Concentration in Water," JOURNAL, New England Water Works Association, Vol. 68, No. 1, Mar, 1954.
3. KENNETH F. KNOWLTON, "Fluoridation by Automatic Control," *Water and Sewage Works*, Vol. 102, No. 2, Feb., 1955.
4. R. H. BABCOCK AND K. F. KNOWLTON, "Conductivity-Difference Control of Chemical Coagulation," JOURNAL, American Water Works Association, Vol. 48, No. 6, June, 1956.
5. K. F. KNOWLTON AND R. H. BABCOCK, "Investigation of Liquid Alum Flow Measurement," JOURNAL, New England Water Works Association, Vol. 73, No. 2, June, 1959.
6. HERBERT E. HUDSON, JR., "Declining Rate Filtration," JOURNAL, American Water Works Association, Vol. 51, No. 11, Nov., 1959.

THE MONTREAL WATER WORKS

By LUCIEN L'ALLIER*

[*Read September 19, 1960.*]

History

From the city's foundation in 1642 up to the year 1800, Montrealers took care of their water needs on their own. Available to them were the various streams on the island, some public wellsprings, the water carters and carriers, and the little wells people dug for themselves.

In 1800, the Montreal Company of Waterworks Proprietors was founded. It obtained a 50-year exclusive privilege. The water, drawn from a source near the old village of Côte des Neiges, was gravity-fed to two reservoirs, one at the corner of Guy and Dorchester Streets, the other at the corner of Berri and Notre-Dame Streets. The wooden mains used in those days often burst, and this in conjunction with other troubles caused the company to sell its privilege and goods.

Two other companies took over, from 1819 to 1845. They made some marked improvements. Cast-iron mains replaced the wooden ones. The water was taken directly from the St. Lawrence. The 4-inch pipes were replaced by more substantial ones of 10 inches. The system used two steam pumps. Montreal's population, which was 9,000 in 1800, had reached 40,356 by 1842.

The Montreal Waterworks was taken over by the municipality in 1845. At first the administration carried on with the existing system. In 1849, a 3,000,000-gallon reservoir was added at the present site of St. Louis Square. The distribution system consisted at that time of 9 miles of cast-iron pipe and 6 miles of lead pipe.

The year 1852 marked a turning point; fire destroyed part of the waterworks plant. This supplied an opportunity to replan the system in order to supply the city more efficiently with water. The plan then conceived remains the basis of Montreal's present waterworks. It included digging a canal which opened a mile

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and a half above the Lachine Rapids and led to the northeast of Verdun where the waterworks buildings are still situated. This canal had a double purpose. It supplied water for consumption and, at the same time, the power to operate two hydraulic wheels which in turn were geared to six pumps having a total daily capacity of 4,000,000 gallons. At the same time a reservoir was installed at the foot of the mountain at the present site of the McTavish reservoir. The works were finished in 1856. Excellent results were obtained, but in a few short years the need ran ahead of the supply.

There were some new difficulties, aggravated by the needs of a growing population, and many new attempts were made to solve them; in fact the history of the waterworks for the past hundred years consists of these successive improvements.

It must be borne in mind that the population of Montreal alone has increased 25 times from 1850 to the present day. Consumption has kept correspondingly rising during this time, so that there has been a continual strain on the production capacity of the waterworks plant.

Then again, the normal working of the system was hindered when, in wintertime, ice from the river obstructed the canal mouth. In 1862 Montreal had to fall back on the system of distributing water by the barrel from door to door.

Among the steps taken to surmount these difficulties were:

1. Enlargement of the aqueduct canal in 1870;
2. Setting up steam pumps, from 1868 onward, to second the hydraulic pumps;
3. Construction of a reservoir at the top of Peel Street in 1875 and enlargement of the McTavish reservoir in 1878;
4. A new enlargement of the waterworks canal in 1895;
5. Installation in 1910 of a new water intake 1200 feet from the river-bank.

Many other plans were conceived and set aside, including the possibility of getting water from the Laurentian lakes and the streams flowing out of them. For the 60 years following 1856, there was fascination in the idea of using the aqueduct canal water to produce cheap power, either to operate the hydraulic

pumps or, as time went on, to generate electricity. Plans of this kind led people to overlook the basic fact that the canal exists to supply Montreal with water. For a half a century the supply was often precarious and occasionally of doubtful quality.

Not until 1910, following a more severe typhoid epidemic than that of the previous year, did the Municipal Council decide to build a filtration plant. The contract was awarded in 1911, but, due to difficulties resulting from the state of war, the work was not completed until 1918. The first filtration plant had a daily capacity of 50,000,000 imperial gallons.

In 1923, a new pumping plant was constructed at the southern extremity of the waterworks canal, and the steam pumps were replaced by electric pumps.

The year 1927 was important. In 1891, a new company for water distribution had been set up under the name of the Montreal Water and Power Company. It supplied Westmount, Outremont and several small municipalities that since then have been annexed to Montreal. It is estimated that by 1927, it was able to supply 30,000,000 gallons of water a day. It took care of a part of the territory acquired by the City of Montreal by annexations. The rates charged by the company and the City of Montreal were not the same and this was the main reason for the expropriation, decreed in 1927 and sanctioned by a board of arbitration in 1928. The main acquisitions by the Montreal Waterworks were the pumping station, the filtration plant, the Outremont reservoir (now Bellingham) and the company's distribution system.

The Montreal Waterworks was able thereafter to develop on a par with the growth of the Metropolis and the neighbouring municipalities. The equipment was modernized; new reservoirs were constructed and the older ones overhauled. In 1927-28, two galleries were added to the filtration plant. Gallery No. 4 was added in 1947, gallery No. 5 in 1958. A sixth gallery, almost completed now, will raise the nominal capacity of waterworks to 300,000,000 gallons daily. In an emergency, its total output may be increased to 360,000,000 gallons per day, and should suffice for the next 5 or 6 years.

Public Works have been generally delayed by the 1939-45 world war and there was no exception for the Waterworks. In

the meantime, due to the expansion of industry, the population of the Island of Montreal had increased at a very fast rate. It is why it was necessary, when peace was signed, to speed up works in such a way as to double the Waterworks capacity in 15 years.

This history remains very incomplete. It nevertheless explains some of the difficulties which the Montreal Waterworks has had to surmount since the municipalization in 1845, when the city had scarcely 40,000 inhabitants, up to the present day when the territory to be supplied has, according to municipal statistics, a population of approximately 1,750,000.

Territory and Population

Before we proceed further, let us look at the geography of Montreal.

The Island of Montreal, bounded by Back River to the north and the St. Lawrence River to the south, has a total area of 194 square miles. The City of Montreal covers one-fourth, or exactly 50.73 square miles. Eighteen municipalities or neighbouring towns and cities likewise get their regular supply from the Montreal Waterworks, which therefore is called upon to service a very extensive territory, featured in the west-centre by the excrescence of Mount-Royal. Altogether the territory amounts to some two-thirds of the area of the island. The balance of the island is served by several smaller systems.

The population of the territory catered to by the Montreal Waterworks is estimated in 1960 at 1,750,000 and is increasing at the rate of approximately 50,000 per year. The City of Montreal alone claims approximately 1,400,00. Montreal's population is tending to become stable, while the surburbs continue to grow at a rapid rate.

Many matters of the island of Montreal must be resolved at a higher level of government because they involve several municipalities. This is why the Provincial Government has created the Montreal Metropolitan Corporation 18 months ago. However, the supply of water on a metropolitan basis was settled more than 30 years ago and the Montreal Waterworks system was developed accordingly.

The elevation of this territory varies from a few feet above

mean sea level along the river fronts to 750 feet at the highest point of Mount Royal. Pointe-aux-Trembles, the most easterly municipality of the island, is 18 miles from the filtration plant. The larger portion of the territory, and the most heavily populated and industrialized is so located that it can be served from the lower level and the next level of pumping; however to serve the higher spots, in the vicinity of Mount Royal, three additional levels of pumping are required.

Source of Supply

The St. Lawrence River drains a million square miles of territory. It is the overflow from the Great Lakes. It flows right past Montreal's doorstep. It carries vast quantities of limpid, medium-pure water. If all the water that flows in ten hours could be stored up, then, according to calculations, this would suffice for the needs of Montreal and district for a whole year. This, then, is an inexhaustible source and, in its natural state, of almost ideal quality.

The present water intake was constructed in 1951. It is situated a mile and a half above the Lachine Rapids. It consists of four conduits of prestressed concrete, 7 feet in diameter, set into the riverbed, the mouths of which, perpendicular to the current, open in a concrete block 216 feet by 38 feet. The water intake is 1,800 feet from the river-bank and draws solely upon the currents of the St. Lawrence. It was carried out to that distance in order to avoid the water of the Ottawa River, which joins the St. Lawrence 13 miles upstream and runs close to the shore.

Upon reaching the shore, the water enters an open canal, 160 feet wide at the surface and 16 to 18 feet deep. Sluice gates at the entrance regulate the flow. The canal itself is approximately five miles long from the river-bank at Ville LaSalle to its end in the lower part of Atwater Street. The water takes about 40 hours to go from the river to the filtration plant.

The quality of the water there obtained from the St. Lawrence River is such that it can be filtered without the addition of chemical and without coagulation. Its turbidity varies between 2 and 10 p.p.m. on the average. Conditions were sometimes very different when the St. Lawrence Seaway work was underway.

Only chlorine is added after filtration. Average pH is 8 and total hardness 127 p.p.m.

We never had much trouble with algae, except in the last 3 or 4 years with *Melosira* which is present in large quantity at variable times during the fall and the winter. Filter runs which are normally 96 hours are sometimes reduced to less than 24 hours on that account.

Except for the above, we enjoy probably the best kind of raw water which, coming from the Great Lakes, is as pure and plentiful as any operator can ever expect to get.

Occasionally, because there is very little sewage treatment done on the island and upstream, people will tell Montrealers that they are drinking water coming from the sewers. But it is not so and only few large cities that I know have such raw water available in abundance at their doorstep.

The Filtration Plant

As it reaches the end of the aqueduct, the water is elevated directly to the rapid sand filters by 5 pumps having a capacity of 50 m.g.d. each and a number of smaller pumps. It is then distributed to six filter galleries. Each gallery contains 16 filters having an area of 1200 sq. feet each and capable of delivering 50 m.g.d. when operated at the rate of 2 gals/minute/sq. foot.

This year, in the 6th gallery, we have just completed the installation of a miscrostrainer unit of a capacity of 8,000,000 gallons per day. It will be in service very shortly and we are very anxious to see what effect it will have toward eliminating *Melosira* and other algae before they get to the fiter beds. This unit will be opened as a pilot plant, on an experimental basis, and if the results are satisfactory, we may decide to install more such units after studying the economics of their operation.

At the site of the filtration plant, there are two underground reservoirs with a total capacity of some 70,000,000 gallons. This relatively large storage makes possible the operation of the filters at a steady rate. One of these reservoirs is a slow sand filter which was abandoned years ago. From these 2 reservoirs, the water flows to another 20,000,000-gallon reservoir. On the way, the proper quantity of chlorine is injected automatically.

The 6th filter gallery houses a new laboratory containing

modern equipment where technicians verify the quality of the water not only at the output of the plant but from several sampling points all over the town.

Distribution

There now remains the task of ceaselessly distributing purified, safe and abundant water everywhere it is needed. The distribution must beat distance and altitude.

From the site of the filtration plant to the eastern end of Montreal Island is a distance of 18 miles. In the west-centre of the supplied territory rises Mount Royal to a height of more than 750 feet. The mains must service an extended terrain of variable elevation.

This 130 to 140 square miles of territory is divided into five supply zones dependent upon reservoirs situated at higher levels.

Always full, the reservoirs balance the distribution, maintain a steady pressure in the mains and constitute an emergency reserve.

Five of these reservoirs are on the top and slopes of Mount Royal. The sixth is on the Rosemount elevation. These reservoirs have an aggregate capacity of 138,300,000 gallons. With the exception of Bellingham, they are all covered.

The following table shows their capacity and their elevation at the line of maximum level:

Reservoir	*Elevation*	*Capacity*
McTavish	231.17 feet	33,000,000 gallons
Bellingham	387.38 feet	45,000,000 gallons
Côte des Neiges	497. feet	7,100,000 gallons
Summit	657. feet	3,000,000 gallons
Mount Royal	749.4 feet	200,000 gallons
Rosemount	220. feet	50,000,000 gallons

The McTavish reservoir gets its supply from the central pumping plant near the filtration plant. In turn, it supplies the Bellingham and Côte des Neiges reservoirs. The latter supplies the Summit and Mount Royal reservoirs. As for the Rosemount reservoir, it is, like McTavish, fed directly by the central pumping plant.

Supply Zones

The supply zones divide the territory in a very unequal way. The lower zone is largely composed of the southern part of the Island of Montreal, from and including Verdun, as far as Pointe-aux-Trembles. Besides these two towns, it also includes Ville St. Pierre, a good part of Montreal, St. Jean de Dieu and Montreal-East. At its extreme points it reaches about 145 feet above sea level. It is supplied by the McTavish and the Rosemount reservoirs.

The second zone is still more vast. It consists of the northern watershed of the Island of Montreal from Saraguay and Ville St.-Laurent as far as Montreal North. In whole or in part it takes care of Montreal West, Côte St. Luc, Westmount, Outremont, the Town of Mount Royal, Ville St. Michel, Montreal North, Montreal, etc. The highest points it services are in the neighbourhood of 285 feet. The Bellingham reservoir regularizes the pressure of this zone.

The third zone depends upon the Côte des Neiges reservoir. Quite small as compared with the two already mentioned, it is constituted by the higher sections of Westmount, Outremont and Montreal. It reaches from 285 to 385 feet above sea level.

Finally, Summit reservoir supplies the highest points of Westmount, Montreal and Outremont, while the Mount Royal reservoir provides water for Mount Royal Park and some of the nearby buildings. The last two zones are by far the smallest. All the reservoirs float on the system.

The Pumps

All the water contained in the reservoirs could not supply the territory for half a day. The regularity of the supply depends upon the uninterrupted working of electrical pumps.

1. The central pumping plant at the bottom of Atwater Street has 12 pumps with 30,000,000 gallons capacity each. It pumps water into the trunk mains of the lower zone, to McTavish reservoir at 231 feet elevation, and the Rosemount reservoir at 220 feet.

2. The pumping station of the McTavish reservoir has 10 pumps with capacities varying from 10,000,000 to 35,000,000

gallons per day, and in turn raises water up to the Bellingham and Côte des Neiges reservoirs.

3. A final station, that of Côte des Neiges, has four pumps having daily capacities from 1,000,000 to 2,000,000 gallons, and fills the highest reservoirs, Summit and Mount Royal.

We do not have any steam or gas driven pumps. Fortunately, the power failures are rare.

Trunk and Service Mains

A highly complex network of trunk and service mains underlines the territory which the waterworks serves. It comprises in excess of 1,300 miles of mains, of which 100 miles are trunk mains varying from 24 to 48 inches in diameter. The oldest were made of steel and cast iron. But since 1934, Montreal has been using reinforced concrete mains.

Six trunk mains of 48-inch diameter go out from the central pumping plant near the filtration plant, first following the direction of Atwater Street, then subdividing to supply the lower zone, the McTavish reservoir and the Rosemount reservoir.

The City of Montreal owns not only the local system of distribution within the city, but also that in Ville St. Pierre, Côte St. Luc, Saraguay, Westmount, Outremont, Montreal East and Pointe aux Trembles. Today, it exceeds 1,200 miles.

Montreal's first cast iron pipe was laid in 1816. A pipe of the same material laid in 1833, was still in service a few years ago. There are some 17,000 valves, 8,500 hydrants and approximately 1,200 meters in service.

Consumption

In 1959, the following quantities were pumped:

Maximum day:	276,000,000 gallons
Minimum day:	186,000,000 gallons
Average day:	227,000,000 gallons

Ratio of maximum day to average day = 1.22

The average consumption per capita is 128 gallons per day.

Approximately 80% of the water pumped is used within the limits of the city, the remaining 20% being supplied to the adjoining municipalities.

The water consumption presently increases at the rate of 6 to 7 million gallons per day—every year.

The use of water is governed by By-law No. 2034, enacted in 1953.

Future Improvements and Extension of the Waterworks

Since 1947, Montreal has spent close to $60,000,000 to improve the Waterworks system and to bring it to the present nominal capacity of 300 m.g.d., to install trunk and local mains, rebuild existing reservoirs and build new ones.

But this is not enough yet and, as you all well know, those responsible for keeping a municipal waterworks running smoothly can never have time to sit down and watch the water flow. The same tasks have to be done continuously: upkeep, renewal, expansion.

Equipment and buildings run their span and then must be replaced and reconditioned.

Preparations are being made to repair the oldest buildings of the filtration plant. At the central pumping station four pumps dating from 1921 to 1927 will shortly be replaced. New motors will also be installed. One million has been voted to renovate the electrical distribution system at the filtration plant and at the pumping stations.

Trunk mains required to give the system more flexibility are being installed. Others are being planned and will soon be added. Old cast iron and steel mains will be reconditioned. We are also getting interested in automation.

Conceived for an ever growing population, the Waterworks system retains the characteristics of ever growing life. To keep it up to date, it is expected the city will spend in excess of $25,000,000 during the following six years.

Administration

The Montreal Waterworks system is under the jurisdiction of the Public Works Department which, in turn, of course, is dependent upon the Municipal Council and its Executive Committee.

The responsibilities of the Director of Public Works of the City, among others, include the construction and maintenance of

public works of all nature, including bridges, sewers, street lighting, traffic signals, fire alarm and public buildings for all purposes; the construction of sidewalks, pavements, park facilities, etc. It also includes the operation of the municipal shops where some 2,500 vehicles are serviced and repaired.

The Director of the Department is also charged with all construction work for the waterworks and for its operation and maintenance.

The Department is divided into 11 divisions, two of which have to do with the waterworks.

1. The Waterworks technical division is responsible for conceiving and executing plans and projects suitable for maintaining the entire system in a perfect state of efficiency.

2. The Waterworks and Sewerage division is responsible for the operation and the maintenance of the whole waterworks system. It is also charged with the maintenance and operation of the entire sewer system of the city.

The staff in the two divisions consists of some 40 engineers, 107 office clerks, 37 foremen and assistant foremen, and some 800 manual employees of various trades. Certain temporary works call for the employment of some hundred or more additional workers.

Practically all maintenance work is done by City forces, but contracts for new works are let to contractors after public tenders have been received.

Annual Revenue and Rates

All the revenues derived from the water tax, estimated at $28,600,000 for 1960, go in the general fund of the City. The Waterworks operates on a budget voted in March of each year by the City Council. The money for extensions to the system is provided as part of the loan by-law, which is approved every year for Capital Expenditures.

If the fore-mentioned revenue from the water tax appears to you somewhat high, I should explain that the citizens of the city pay, as water tax, 6% of the assessed annual rental of the building, office or apartment which they occupy. This includes their supply of water but also includes other services rendered to them by the City. In other words the so-called "water tax" is really an occupancy tax.

For this reason, we have relatively few water meters in the City. In fact, water meters are installed mostly in industries, businesses or other places where the amount of water used may be such that the owners would actually be expected to use more water than what they would be entitled to otherwise on the basis of the 6% assessment. The value of water used is calculated at 18½ cents per thousand imperial gallons. (App. $1.15 per cu. foot). To these consumers, the minimum water bill is 6% of the assessed rental value and that gives them the right to a certain amount of water; if they consume more, they are billed for the difference. This rate structure applies within the city itself.

The rate structure which applies outside of the city varies:

1. Several municipalities own their distribution system and buy water wholesale. The rate which applies was approved by the Public Service Board in 1958: 25 cents per 1,000 gal. for the first 600 million gallons per year; 20 cents for the next 600 million gallons; 18½ cents for the surplus.

2. In the municipalities where Montreal owns the distribution system, it bills the consumers directly. In some of these municipalities a tax similar to that of Montreal applies: that is a certain percentage of the assessed rental value. In others, water is fully metered and sold at 45 cents per 1,000 gallons, with a minimum bill of $9.00 per quarter.

There is no charge for hydrants and the municipalities are not charged for water for street cleaning and fire fighting. Contracts are for ten years, and when new main extensions are required, the municipality must be prepared to guarantee a minimum revenue of 10% of the cost.

The revenue in 1960 for water sold outside the city boundaries is estimated at about $2,600,000.

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PROCEEDINGS

Seventy-Eighth Annual Convention
Queen Elizabeth Hotel, Montreal, Canada
September 19-21, 1960

The Seventy-Eighth Annual Convention of the New England Water Works Association was held at the Queen Elizabeth Hotel, Montreal, Canada, on September 19-21, 1960.

The technical sessions of the Convention were held in the Duluth Room on the Convention Floor of the Hotel; the Manufacturers' exhibits were located in Galleries 2, 3 and 4.

Monday, September 19

Morning Session

President Warren A. Gentner in the Chair.

The Annual Reports of the Secretary, Treasurer, Editor, Finance Committee, Membership Committee, Scholarship Committee, Committee on Committees, Committee on Library, Committee on Legislation, and Committee on Reciprocal Relations with the Institution of Water Engineers were presented and accepted.

The President declared the polls closed and appointed the following as Tellers of Election: G. Arthur Faneuf, Chairman, Lawrence K. Engdahl, and Sherman L. Rogers.

Reports of the following technical committees were presented and accepted: Committee on Specifications for Cast-Iron Pipe and Fittings, Committee on Standard Specifications for the Installation of Cast-Iron Water Mains, Committee on Standardization of Pipes Flanges and Fittings, Committee on Steel Standpipes and Elevated Tanks, Committee on Hydrant Specifications, Committee on Deep-Well Vertical Pumps, Committee on Conservation, Development and Utilization of Water Resources, Committee on Water-Works Safety Practice, Committee on Specifications for Prestressed Concrete Water-Storage Tanks,

Committee on Water Rates, Committee on Meters, Committee on Gate Valves, Committee on Plastic Pipe, and Committee on Reinforced-Concrete Pipe. These Reports are printed in this issue of the Journal.

Secretary Knox announced the election by the Executive Committee of the following new members: Theodore L. Chmura, Superintendent, Webster, Mass.; Francis X. Dalton, Superintendent, Water Department, Winthrop, Mass.; Frank G. Gagliardi, Superintendent, Water Department, Willimantic, Conn.; Frederick T. LeBaron, Superintendent, Water Department, Mattapoisett, Mass.

Afternoon Session

A paper on "The Montreal Water Works" was read by Lucien L'Allier, Director of Public Works, Montreal, Canada.

A paper on "Ghosts of the Past, Visions of the Future," prepared by E. Sherman Chase, Consultant, Metcalf & Eddy, Boston, Mass., was read by Edwin B. Cobb.

Evening

A Royal Frolics Revue was given in the Grand Salon of the hotel, compliments of the New England Water Works Association.

TUESDAY, SEPTEMBER 20

Morning Session

A paper on "Study of Ground-Water Resources in Mattapoisett River Valley in Massachusetts," prepared by Clarence I. Sterling, Jr., Director and Chief Engineer, Massachusetts Water Resources Commission, Boston, was read by Paul T. Anderson.

A paper on "The Ontario Plan in the Administration of Water Resources" was delivered by Dr. Albert E. Berry, General Manager, Ontario Water Resources Commission, Toronto, Ontario.

WEDNESDAY, SEPTEMBER 21

Morning Session

A paper on "Radioactive Fallout and Drinking Water" was presented by Ernest A. Snow, Senior Chemist, Massachusetts Department of Public Health, Amherst, Massachusetts.

A paper on "Water-Borne Typhoid at Keene, New Hampshire," prepared by William A. Healy, Director, and Richard P. Grossman, Senior Sanitary Engineer, Division of Sanitary Engineering, New Hampshire Department of Health, Concord, N.H., was read by Mr. Grossman.

A paper on "Use of Ozone in Water Works as Installed in Some Municipalities in the Montreal Region," prepared by Charles E. Gravel, Consulting Engineer, L'Abord-a-Plouffe, Quebec, was presented by J. B. Norbert, a professional engineer associated with the Gravel Construction Company.

Afternoon Session

A paper on "Water Quality Management," prepared by Harry G. Hanson, Director, Taft Sanitary Engineering Center, U.S. Public Health Service, Cincinnati, Ohio, was read by Joseph E. Flanagan, Assistant Director of the Center.

A paper on "Major Valve-Replacement Program in Bridgeport, Connecticut," was presented by Kenneth E. Bender, Superintendent of Distribution, Bridgeport Hydraulic Company, Bridgeport, Conn.

A paper on "A New System for Protection of Unattended Pumping Stations," prepared by R. R. Rawson and C. A. Drews of Cutler-Hammer, Inc., Milwaukee, Wisconsin, was presented by John A. Anderson of Culter-Hammer, Inc.

Evening Session

Beginning at six o'clock a Social Hour was enjoyed in Gallery 1 of the hotel, followed by a Banquet in the Grand Salon, both functions with the compliments of the Water and Sewage Works Manufacturers Association.

President Gentner introduced Harry P. Loftus, Chairman of the Awards Committee, to make the presentation of the awards.

AWARD OF THE DEXTER BRACKETT MEMORIAL MEDAL

HARRY P. LOFTUS. Mr. President, distinguished guests, officers, members of the New England Water Works Association, ladies and gentlemen. This is the time in our convention festivities when we traditionally pause to recognize the author of the outstanding technical paper published in the New England Water Works Journal the last year.

The Dexter Brackett Memorial Medal was instituted in 1916 in honor of Mr. Brackett, who for many years was the Chief Engineer of the Metropolitan Water Board of the City of Boston. Your committee this year, which consisted of William D. Monie of the Portland Water District, Kenneth E. Bender of the Bridgeport Hydraulic Company and myself, have chosen to refer back to the Metropolitan Water District in presenting the medal to one of the design engineers for his excellent paper on the Marlboro and the Wachusett Tunnel. I should like at this time to have Chester J. Ginder, Design Engineer for the Metropolitan District Commission, step up to the speakers' platform. (*Mr. Ginder comes forward.*) [*Applause*]

Mr. Ginder, ours was a most difficult task this year due to the large number of excellent papers presented in the Journal in 1959. However, on behalf of the New England Water Works Association, it gives me the greatest of pleasure to present you this medal for your excellent paper. [*Applause*]

CHESTER J. GINDER. I wish to thank you and the Association very much for this honor. I appreciate it very much. I have enjoyed my association with the organization and consider this an added dividend. I thank you. [*Applause*]

COMMEMORATIVE AWARD

HARRY P. LOFTUS. The Commemorative Award does not go back quite as far as the Dexter Brackett Memorial Medal but it goes back for the last ten to twelve years, and this year it is given in memory of David E. Heffernan. Mr. Heffernan was superintendent of the Milton, Massachusetts, water department from 1902 to 1937. He was president of this Association in 1923. He was active on various committees during his membership in the Association. He presented nine papers, which is certainly a goal for some of us other superintendents to shoot at, and was presented the Dexter Brackett Award for one of them.

Tonight I wish to present the Commemorative Award to another waterworks engineer—Mr. Peter C. Karalekas, Chief Engineer of the City of Springfield. [*Applause*] [*Mr. Karalekas steps forward.*]

Peter, it gives me the greatest pleasure to make this presentation to you tonight. [*Applause*]

PETER C. KARALEKAS. Thank you very much, Harry, and you people out there. It is with great pride and humility that I accept this award. I am sure that there are many of you people out there who have prepared papers which were more deserving than mine. I shall always cherish it with great pride. Thank you very much. [*Applause*]

* * * *

PRESIDENT GENTNER. Each year the Association presents 25-year certificates to people who have been members of this Association for 25 years and who have also served the same community for an equal or greater number of years. There are five recipients of this certificate this year. As I read their names I wish they would please come forward and receive the certificates.

Philip J. Holton, Jr., Chief Engineer, Water Supply Board of Providence, Rhode Island. [*Applause*]

James A Sweeney, Superintendent of Waterworks of Manchester, New Hampshire. [*Applause*]

William J. C. Marshall, Superintendent of the Water Department of Georgetown, Mass. [*Applause*]

Charles H. Tompkins, Chairman of the Water Board, Town of Somerset, Mass. [*Applause*]

The fifth recipient, Paul Pazziani, is Director of the Water Services in Geneva, Switzerland, and for obvious and excusable reasons is not present in person to receive his certificate, but it will be mailed to him. [*Applause*]

PRESIDENTIAL ADDRESS

By Warren A. Gentner

The section of the Constitution of this Association which defines the duties of its president reads in part as follows: "He shall deliver an address at the Annual Convention." I can see no loophole.

We have now reached that point in the evening's proceedings at which it becomes incumbent upon me to comply with this edict, for which I ask your indulgence for the next few minutes.

Last year at Lake Placid, Montreal was by far the most popular choice for this year's convention site. The registration of 584 at this year's convention attests to the fact that it was indeed a popular choice, and Montreal, with it many points of interest, plus the excellent convention facilities offered at this hotel, has proven out an ideal convention city. We are deeply appreciative of the cordial reception accorded to us and for the courtesies extended to us during our brief visit. As we return to our homes we shall carry with us many pleasant and worthwhile memories of what has here transpired.

The objective of the Association, as set forth in the Constitution, is to advance knowledge relative to waterworks and water supply and to encourage professional and social intercourse among the waterworks men.

To implement these aims the Association has provided certain essential tools, which include the holding of monthly meetings for open discussion of subjects relating to all phases of water supply, construction, operation and treatment, and presentation of technical papers pertaining thereto, a Water Works School offering a series of lectures on water-works hydraulics, a quarterly issued Journal in which are published papers presented at the monthly meetings along with the Proceedings of the Association, a reference library maintained at the Boston office which contains the latest texts and references to water-supply subjects, and finally the reports of the Association technical committees, which afford the members the opportunity of keeping up to date on the latest developments in water-works specifi-

cations, standards and practices. To fulfill the social obligations there are the monthly meetings, luncheon-table and in-corridor get-togethers, the June conferences and the annual conventions.

The benefits which you and I, and the water-works companies which we represent, derive from our membership in this association depend to a very large extent on the use which we make of those tools.

Assuming it to be the aim of the Association to provide the fullest measure of service to its members that it can, the time may be ripe for a general review and reappraisal of the aims and objectives of the Association, to determine, through a committee and a canvass of the members, whether or not there are additional services which the Association could and should provide to its members.

The Association 1960 Directory of Members, which was issued earlier in the summer, contains the names of 1148 members, classified as follows: 951 members, including 13 honorary and 2 junior members, 43 Corporate, and 154 Associate members. Of the 951 members listed, 797 are located in New England. If you were to classify further the New England membership you would find 469 are actively engaged in the operation or management of some 273 New England water-supply systems, 147 are affiliated with consulting engineers or contracting firms, 35 are in public health service, 17 are in educational fields, 55 represent suppliers of water-works equipment or material, 9 are in various branches of governmental service, and 65 are unlisted as to professional or business connections. Most of the latter group are Life Members.

In addition to the 273 water-supply systems represented above, there are 23 systems holding Corporate membership only. In the entire New England area there are some 645 water-supply systems serving populations of 1,000 or more.

My principal purpose in reciting the foregoing statistics is to point out the fact that there are still well over 300 water systems throughout New England, each supplying a population of 1,000 or more, which have no membership in this Association —a situation which would appear to offer a fruitful source for adding to our membership.

As of September 1, 1960, the total membership stood

at 1154. During the year 69 new members were added and there were 64 withdrawls due to resignation or death, making a net gain of five. Our monthly meetings during this year have been well attended, and the June conference at Swampscott attracted a record attendance of 410. The 584 people who have registered at this convention places this fifth in point of attendance at a convention held outside the City of Boston.

The successful functioning of this Association is due to the efforts of many people, but I can think of no single group which does more to promote and maintain our interest as representatives of the water-supply industry than the Technical Program Committee, which was this year headed by Paul F. Howard as chairman, assisted by Clifton E. Hodgdon and I. Laird Newell as chairman of the superintendents' and chemists' sessions respectively. The committee did an excellent job and it is to be highly commended for lining up speakers and papers covering such timely and diversified subjects as were offered during the year.

I should like at this time to express our appreciation to all those who contributed of their time and talents in the preparation of papers and presentation in meetings and services on technical committees during the year.

Thanks to the Finance Committee, under the chairmanship of James W. Reilly, we were provided with a sound budget on which to set our course during the year.

The Association is deeply indebted to three people in particular for their day-to-day work in handling its affairs: To William P. Melley, our Treasurer, for so ably handling our finances and for his diligence in keeping the expenditures within the framework of the budget, and to Secretary Knox and Mrs. Alice Hathaway for their continuous efficiency in handling the numerous details involved in running an organization of this size and type.

The success of our convention and the June conference is due in no small part to the support which we receive from the Water and Sewage Works Manufacturers Association, of which George W. Kelsey is president and John G. Stewart is manager. We deeply appreciate their interest in our organization and

their substantial contribution towards the success of this and previous conventions and conferences.

We owe our sincere thanks and congratulations to Mrs. Kenneth W. Robie, chairman of the Ladies' Entertainment Committee, and to John B. Donohoe, chairman of the Water and Sewage Works Manufacturers Entertainment Committee, and to their associates, for the very excellent entertainment and interesting program which they have provided for our entertainment here in Montreal.

I wish to express my personal appreciation for the splendid cooperation extended to me during the year by the officers of the Association and the Executive Committee, who were charged with the duty of formulating and discharging the policies of the Association.

Now as I am bringing my Presidential Address to a close I wish again to express my very sincere appreciation for the honor conferred upon me by my election to the office and for the privilege of having so served. It has been a wonderfully satisfying year and an experience which I shall always cherish. I thank you.

PRESIDENT GENTNER. Now I will call upon Mr. G. Arthur Faneuf for the report of the Tellers of Election.

G. ARTHUR FANEUF. Mr. President and members of the New England Water Works Association, I hereby present the report of the Tellers of Election:

REPORT OF THE TELLERS OF ELECTION

Total number of ballots cast	410
FOR PRESIDENT: Kenneth W. Robie,	409
FOR VICE PRESIDENT: Walter J. Shea,	407
FOR DIRECTOR: Paul F. Howard,	404
FOR TREASURER: William P. Melley,	409

Respectfully submitted,

G. ARTHUR FANEUF, *Chairman*
LAWRENCE K. ENGDAHL
SHERMAN L. ROGERS

PRESIDENT GENTNER. Thank you, Mr. Faneuf. I hereby declare the slate as read to be the duly elected officers of this Association.

Now it is my very pleasant duty to present to you your new president. He has been an active member of this Association for some 23 years. He is a real beaver for work because he is not only the superintendent of water but he is superintendent of highways in his home town of Brookline, Mass. It is with great pleasure that I now hand the gavel over to Kenneth W. Robie. [*Applause.*]

PRESIDENT KENNETH W. ROBIE. I am deeply gratified at this high honor and shall endeavor to carry on the great traditions of this honorable association—of course, with the help of the Executive Committee, the Secretary and Assistant Secretary and the Manufacturers Association. I feel quite humble when I look back over the long list of outstanding men who in the past have occupied the presidential chair.

My first official act is to present Warren Gentner, on behalf of the Association, the Past President's certificate and to congratulate him on his successful administration and to welcome him as a continuing member of the Executive Committee. [*Applause.*]

You know there is a little gimmick in our Constitution. When a president retires they still keep him on the Board to keep the new president from going haywire. It is a good idea. [*Applause.*]

My second official act is to declare this, the 78th and very happy Annual Convention of the New England Water Works Association, adjourned, and to say *au revoir* until the November meeting at the Statler. And as an additional note, you are cordially invited to enjoy dancing in Gallery No. 1.

[*Adjourned*]

ANNUAL REPORT OF THE SECRETARY

August 31, 1960

Mr. President, and Members of the New England Water Works Association:

The Secretary herewith submits the following report of the changes in the membership during the past fiscal year, and the general condition of the Association.

The present membership is 1,154 constituted as follows: 13 Honorary Members, 949 Members, 2 Junior Members, 147 Associates and 43 Corporates.

MEMBERSHIP

					Total
Sept. 1, 1959	Honorary Members, total		14		
	Withdrawals:				
	Died	1	1		13
Sept. 1, 1959	Members, total		937		
	Withdrawals:				
	Died	11			
	Dropped	12			
	Resigned	30	53	884	
	Elections:				
	September 20, 1959	7			
	October 22, 1959	3			
	November 19, 1959	1			
	December 17, 1959	4			
	January 21, 1960	5			
	February 18, 1960	14			
	March 17, 1960	11			
	April 21, 1960	3			
	May 19, 1960	4			
	August 18, 1960	13		65	949

Sept. 1, 1959	Junior Members, total		2[1]		2
Sept. 1, 1959	Associate Members, total		155		
	Withdrawals:				
	Dropped	2			
	Resigned	8	10	145	
	Elections:				
	January 21, 1960	1			
	February 18, 1960	1			
	March 17, 1960	1		3	147
Sept. 1, 1959	Corporate Members, total		42		
	Elections:				
	November 19, 1959	1	1		43
	Total membership, September 1, 1960				1,154
	Total membership, September 1, 1959				1,149
	Gain of				5

ELECTIONS

Members

September 20, 1959—Francis H. Grant, Willard W. Harris, Gordon L. Kirjassoff, John D. Marr, Jr., Dudley S. Richards, Worthen H. Taylor, Arthur L. Whitten. (7)

October 22, 1959—William P. Coues, Robert A. Gannon, Harry C. Ritchie. (3)

November 19, 1959—Robert J. Smith. (1)

December 17, 1959—Edwin D. Callahan, John H. Driscoll, Herbert D. Nickerson, John C. Nordeste, Jr. (4)

January 21, 1960—Robert C. Marini, Frank Morgenroth, William W. Nelson, Harry H. Reed, Jr., John A. Worthley. (5)

February 18, 1960—William Ammann, Philip J. Barbato, John J. Carroll, Richard D. Chinnock, Donald E. Cullivan, Cormello Dorio, Charles H. Flavin, Jr., John O. Grace, John M. Kinsey, Robert A. McCracken, John W. Meany, John K. Mitchell, Henry P. Tilden, Jr., Harvey S. Westover. (14)

March 17, 1960—Floyd E. Brown, Howard G. Egginson, Edward H. Fletcher, Allan Grieve, Jr., Wesley R. Hazelton, Warren H. Oster,

Stuart C. Peterson, J. Andre Provencial, John M. W. Sargent, George E. Sherman, Warren M. Walkup, Jr. (11)

April 21, 1960—Irving C. LaMay, Carleton P. Mann, Barney Moses. (3)

May 19, 1960—Clarence E. Allen, George Dyson, Louis C. McGowan, Walter J. Pulawski. (4)

August 18, 1960—John E. Allen, Jr., Robert S. Bancroft, William A. Barnes, David W. Beach, Francis H. Ferraro, Maurice M. Gordon, Scott O. Holt, John H. Long, Howard J. Rose, Carleton W. Scott, Russell J. Sharpe, Frank M. Sousa, Frederick F. Taussig. (13)

Associate Members

January 21, 1960—Clavin-Fielding Company. (1)

February 18, 1960—Prufcoat Laboratories, Inc. (1)

March 17, 1960—Rotary Valve & Engineering Corp. (1)

Corporate Members

November 19, 1959—City of Lebanon, New Hampshire. (1)

WITHDRAWALS

Members

Died—Thomas W. Clark, Irving B. Crosby, William F. Fouhey, Harold W. Griswold, John L. Howard, Patrick J. Lucey, Robert W. Moir, Caleb Mills Saville, Robert L. Taylor, John G. W. Thomas, E. J. Titcomb, Robert C. Wheeler. (12)

Dropped—Howard B. Allen, Roger F. Duwart, Joseph W. Gerniglia, Francis W. Hamilton, John A. Hastings, Kenneth H. Holmes, Laban C. Morrill, Ernest F. Pike, Philip K. Reddy, Michael B. Rossi, Morton F. Sampson, Ira M. Sanborn. (12)

Resigned—Kenneth G. Barnhill, Louis C. Campbell, Charles J. Christy, William R. Colton, Ernest R. Coutermarsh, John M. Diven, Edward S. Duarte, Joseph K. Fairbanks, Richard J. Gayer, Alfred W. Garnell, Joseph M. Hackett, Henry N. Halberg, Charles W. Harris, Robert A. Kaufman, Alice M. Keiran, Harry W. Kendrick, John P. Keon, Harold E. Langley, Jr., Ralph I. Larson, H. Russell Medding, Jr., Edwin M. Montstream, Walter L. Norrington, Morris A. Nussbaum, Grant H. Potter, Eric Schaefer, Williard P. Sheppard, Irving B. Smith, Sydney R. Stapley, James M. Symons, Earle Talbot. (30)

Associate Members

Dropped—Inertol Company, Sherman Products, Inc. (2)

Resigned—The Bond-O Company, Burgess-Manning Company, Penn. Inst. Div., Industrias Espanolas, S.A., The Pitometer Associates, Inc., Allied Chemical Corporation, Plastics & Coal Chem. Div., Simplex Valve & Meter Div., Sparling Meter Company, Tredennick Company. (8)

RECEIPTS FOR THE FISCAL YEAR SEPTEMBER 1, 1959 TO AUGUST 31, 1960

Entrance fees	$ 207.00
Dues, members of all grades	11,109.50
Interest	524.57
Advertising	5,997.75
Subscriptions	793.50
Sale of Journals	48.29
Membership certificates	68.00
Convention registration fees	2,695.00
Miscellaneous	14.67
	$21,458.28
Less: Withholding Taxes	291.17
	$21,167.11
There is due the Association:	
Dues	242.00
Advertising	120.00
	$ 362.00

Respectfully submitted:

JOSEPH C. KNOX, *Secretary*

ANNUAL REPORT OF THE TREASURER

Boston, September 7, 1960

To William P. Melley, Treasurer
New England Water Works Association
Boston, Massachusetts

We have examined the statement of assets and funds and the statement of cash receipts and disbursements of the general fund and the scholarship fund of the New England Water Works Association for the year ended August 31, 1960. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

We traced all recorded receipts into the depositary banks, verified the general fund bank account and petty cash fund and the scholarship fund bank account as at August 31, 1960, and examined properly approved vouchers for all disbursements. We verified the cash on deposit in savings banks by direct communication, and the paid-up cooperative bank shares by examination at the First National Bank of Boston on September 2, 1960.

In our opinion, the accompanying statement of assets and funds and the note thereon and the related statement of cash receipts and disbursements of the general fund and the scholarship fund present fairly the financial position of the New England Water Works Association at August 31, 1960, and the recorded cash receipts and disbursements for the year then ended, on a cash basis consistent with that of the preceding year.

(*signed*) SCOVELL, WELLINGTON & COMPANY

Statement of Assets and Funds (Exhibit A)

As at August 31, 1960

	Assets		
Invested funds assets			
Cash in savings banks			
Boston Five Cents Savings Bank	$ 5,925.88		
Provident Institution for Savings	5,974.32	11,900.20	
Securities			
Braintree Co-operative Bank, 5 paid-up shares	1,000.00		
Sandwich Co-operative Bank, 10 paid-up shares	2,000.00	3,000.00	14,900.20
General fund assets			
Cash, First National Bank of Boston		6,846.40	
In office		50.00	
		6,896.40	
Furniture and fixtures		1,180.00	8,076.40
Scholarship fund asset			
Cash, Milton Co-operative Bank			13,102.88
			$ 36,079.48
	Funds		
Invested funds			$14,900.20
General fund			
Balance, August 31, 1959		8,706.04	
Excess of disbursements over receipts, Exhibit B		(629.64)	
Balance, August 31, 1960			8,076.40
Scholarship fund, Exhibit B			13,102.88
			$ 36,079.48

Note: The statement above, prepared on a cash basis, includes dues received in advance, $ 6,848, and employees' withholding taxes, $ 280.93. It does not reflect the following:

Accounts receivable, dues	$ 242.00
Due on account of advertising	120.00
	$ 362.00

No depreciation has been taken on furniture and fixtures.

STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS (EXHIBIT B)

For the Year ended August 31, 1960

General Fund

Receipts (exclusive of dues received in advance and employees' withholding taxes)			
Initiation fees		$ 207.00	
Dues, 1959-1960 and prior years		4,261.50	
Convention registration fees		2,695.00	
Interest		524.57	
From publication of Journal			
Advertisements	5,997.75		
Subscriptions	793.50		
Sale of Journal	48.29	$ 6,839.54	
Membership certificates		68.00	
Miscellaneous		14.67	
Total receipts			14,610.28
Disbursements			
Publication of Journal			
Printing	6,522.25		
Reporting	253.00		
Stationery and postage	287.68		
Editor's salary	750.00		
Sundry	18.90	7,831.83	
General and administrative			
Salaries	5,620.00		
Certificates of membership	131.14		
Printing, postage and stationery	314.40		
Office supplies and expense	59.41		
Office rent	1,260.00		
Electricity	98.46		
Telephone and telegraph	251.27		
Auditing	125.00		
Social security taxes	238.38		
Sundry	209.33	8,307.39	
Forward		$ 16,139.22	14,610.28

Disbursements (continued)			
Meetings and committees			
Water works school	125.00		
Printing, postage and stationery	1,413.68		
Convention expense	1,571.05		
Dinners	950.56		
Contribution to June conference	200.00		
Scholarship fund expenses	7.25		
Membership directory	878.87		
Sundry	371.24	5,517.65	
Interest added to savings bank deposits		420.81	
Total disbursements			22,077.68
Excess of disbursements over receipts (exclusive of dues received in advance and employees' withholding taxes for current year)			(7,467.40)
Dues received in advance		6,848.00	
Employees' withholding taxes			
Receipts for current year	280.93		
Less Payments for prior year	291.17	(10.24)	6,837.76
Excess of disbursements over receipts, Exhibit A			(629.64)
Balance, general cash, August 31, 1959			7,526.04
Balance, general cash, August 31, 1960			
Represented by			
Cash in First National Bank of Boston		6,846.40	
Cash in office		50.00	
			$ 6,896.40
Scholarship Fund			
Balance, scholarship cash, August 31, 1959			$ 12,638.80
Receipts			
Contributions		630.00	
Interest		434.08	1,064.08
			13,702.88
Disbursements—Scholarship			600.00
Balance, scholarship cash, August 31, 1960			
Represented by cash in Milton Co-operative Bank, Exhibit A			$ 13,102.88

ANNUAL REPORT OF THE EDITOR

To the New England Water Works Association:

The Editor submits herewith his report for the year ending August 31, 1960. The financial figures, tabulated in the report, are derived from the report of the Treasurer, which contains a detailed statement of the receipts and disbursements on account of the September and December, 1959, and March and June, 1960, issues of the JOURNAL.

In Table 1 is presented a statement of the material contained in the four issues of the JOURNAL for the past year, while in Table 2 is given a comparison of the JOURNAL for the past year with those for preceding years.

TABLE 1—STATEMENT OF MATERIAL IN SEPTEMBER AND DECEMBER, 1959, AND MARCH AND JUNE, 1960, ISSUES OF THE JOURNAL OF THE NEW ENGLAND WATER WORKS ASSOCIATION

		Number of pages								
		Papers	Proceedings	Total text	Index	Advertisements	Cover and contents	Insert plates	Total pages	Total cuts (number)
Sept.,	1959	99	4	103	0	51	4	0	158	19
Dec.,	1959	24	56	80	9	47	4	5	145	9
Mar.,	1960	83	5	88	0	47	4	4	143	25
June,	1960	92	4	96	0	46	4	1	147	17
Total		298	69	367	9	191	16	10	593	70

Size. The four issues contained 593 pages, of which 367 were text.

Cost. The gross cost of the JOURNAL was $7,831.83, equivalent to $6.79 per member; the net cost was $992.29, equivalent to $0.86 per member.

Reprints. Reprints of papers have been furnished to authors at cost.

TABLE 2.—COMPARISON OF JOURNALS OF THE NEW ENGLAND WATER WORKS ASSOCIATION
FOUR ISSUES FOR FISCAL YEAR ENDING AUGUST 31

	1951[1]	1952[2]	1953[3]	1954[4]	1955[5]	1956[6]	1957[7]	1958[8]	1959	1960
Average edition (copies printed)	1,300	1,390	1,420	1,442	1,476	1,495	1,498	1,578	1,609	1,656
Average membership	957	1,017	1,057	1,077	1,089	1,106	1,110	1,114	1,137	1,152
Circulation at end of year	1,240	1,283	1,331	1,334	1,357	1,387	1,427	1,421	1,446	1,458
Pages of text	423	463	421	436	442	457	418	473	412	367
Pages of text per 1,000 members	442	456	398	405	406	413	376	424	363	318
Total pages, all kinds	703	671	635	652	655	674	626	689	633	593
Total pages per 1,000 members	734	660	601	606	602	610	564	618	557	514
Gross Cost										
Total	$6,069.62	$5,423.98	$5,865.67	$6,108.76	5,898.97	$7,060.88	$6,842.20	$7,287.51	$7,086.29	$7,831.83
Per copy	1.17	0.98	1.03	1.06	1.00	1.18	1.14	1.15	1.10	1.18
Per page	8.64	8.08	9.23	9.37	9.02	10.48	10.91	10.57	11.19	13.20
Per member	6.34	5.34	5.55	5.68	5.42	6.38	6.16	6.53	6.24	6.79
Per member per 1,000 pages	9.02	7.96	8.75	8.71	8.28	9.46	9.85	9.48	9.86	11.44
Per member per 1,000 pages of text	14.99	11.52	13.19	13.03	12.25	13.92	14.72	13.80	15.12	18.50
Net Cost										
Total	$ 351.34*	$1,040.76*	$ 500.97*	$ 513.89*	$ 101.11*	$ 588.09	$ 224.26	$ 701.67	$ 184.53*	$ 992.29
Per copy	0.07*	0.19*	0.09*	0.09*	0.02*	0.10	0.04	0.11	0.03*	0.15
Per page	0.50*	1.55*	0.79*	0.79*	0.15*	0.87	0.36	1.02	0.29*	1.67
Per member	0.37*	1.02*	0.47*	0.48*	0.09*	0.53	0.20	0.63	0.16*	0.86
Per member per 1,000 pages	0.53*	1.52*	0.74*	0.73*	0.14*	0.79	0.32	0.91	0.25*	1.45
Per member per 1,000 pages of text	0.88*	2.20*	1.12*	1.10*	0.20*	1.16	0.48	1.33	0.39*	2.34

1. Including comprehensive index, 1882 to 1950.
2. Including 16 pages of standard specifications.
3. Including 87 pages of standard specifications and recommended practice.
4. Including 71 pages of standard specifications and recommended practice.
5. Including 8 pages of standard specifications.
6. Including 27 pages of standard specifications.
7. Including 47 pages of standard specifications.
8. Including 28 pages of standard specifications.

*Surplus.

Circulation. The present circulation of the JOURNAL is:

Members, all grades	1,154
Subscribers	207
Exchanges	30
Advertisers	67
Total	1,458

JOURNALS have been sent to all subscribers and to advertisers.

Respectfully submitted,

(*Signed*) GEORGE C. HOUSER, *Editor*

REPORT OF THE FINANCE COMMITTEE

August 31, 1960

To the Executive Committee of the New England Water Works Association:

The Finance Committee herewith submits its report on the budget for the year 1959-60, and its recommended budget for the year 1960-61.

The Committee has examined the figures obtained from the records of the Association during the past year, and has consulted with the Treasurer concerning revenue and disbursements for the coming year.

The following tabulation is the estimated and the actual budget for the past year:

REVENUE FOR 1959-60

	Budget	*Actual*
Entrance fees	$ 250.00	$ 207.00
Dues	10,750.00	11,109.50
Interest	450.00	524.57
Advertising	5,800.00	5,997.75
Other Journal receipts	750.00	841.79
Registration fees	2,750.00	2,695.00
Miscellaneous	50.00	82.67
	$20,800.00	$21,458.28
Less Withholding Taxes		291.17
Adjusted total income		$21,167.11

DISBURSEMENTS FOR 1959-60

	Budget	*Actual*
General and Administrative	$8,600.00	$8,026.46
Journal	8,000.00	7,831.83
Meetings and Committees	4,000.00	3,790.08
Net expense of luncheons	700.00	848.70*
Contingencies	700.00	
Membership lists	1,000.00	878.87
	$23,000.00	$21,375.94

The item starred exceeded the budget, and as was voted by the Executive Committee a transfer from Contingencies to this item was made.

The deficit for the year was estimated at $2,200, but the year closed with a deficit of only $208.83, due largely to the fact that operating expenses were held to a minimum.

The invested funds of the Association are $14,900.20.

The following budget is recommended for the year 1960-61:

REVENUE	
Entrance fees	$ 200.00
Dues	11,000.00
Interest	525.00
Advertising	5,800.00
Other Journal receipts	775.00
Registration fees	3,500.00
Miscellaneous	100.00
	$21,900.00
DISBURSEMENTS	
General and Administrative	$ 8,700.00
Journal	7,900.00
Meetings and Committees	4,600.00
Net expense of luncheons	900.00
Contingencies	500.00
Journal Index	1,000.00
	$23,600.00

This budget anticipates a deficit of $1,700 of which $1,000 is for the publication of the Journal Index. The Index is issued every ten years. The deficit, if actually incurred, will be met from the available cash of the Association.

We refer you to the Treasurer's report, which includes the report of the auditors, Scovell, Wellington & Co., for further financial details, and to the Secretary's report for changes in the membership.

Respectfully submitted,

(*signed*) JAMES W. REILLY, *Chairman*
HARRY P. LOFTUS
VICTOR E. MILLER

REPORT OF MEMBERSHIP COMMITTEE

September 15,1960

To the New England Water Works Association:

The Association had a net gain of five members over last year.

The following figures give the membership of the past two years:

As of Sept. 1, 1959		*As of Sept. 1, 1960*	
Members	953	Members	964
Associates	154	Associates	147
Corporates	42	Corporates	43
Total	1,149	Total	1,154

Gain of 5

1960

Losses:			*Elections:*	
Members:			Members	65
Resigned	30		Junior Members	0
Died	12		Associates	3
Dropped	12	54	Corporates	1
				69
Associates:				
Resigned	8			
Dropped	2	10		
Corporates:				
Resigned	0	0		
		64		

Over 200 membership invitations were sent to the principal

officials of practically all of the water utilities in New England whose municipalities or districts had a population of over 500.

The cooperation of the Committee members in furnishing lists of water works officials is deeply appreciated by the Chairman and he extends his thanks to them for their cooperation.

Respectfully submitted,

Howard W. Anderson	J. Porter Hennings
John J. Baffa	Francis J. O'Brien
Donald C. Calderwood	Richard S. Woodhull

(*signed*) GEORGE W. COFFIN, *Chairman*

REPORT OF THE SCHOLARSHIP COMMITTEE

To the New England Water Works Association:

Contributions in the amount of $330.00 to August 31, 1960, the end of our fiscal year, increased the Scholarship Fund to $13,102.88 towards the goal of a $25,000 Scholarship Fund. The amount of interest earned by the Fund which may be used for scholarship loans or grants is $434.08. Announcement of the second scholarship grant of $300 was made at the Seventy-seventh Annual Convention at the Lake Placid Club in New York to Alan E. Ferry, a Junior Member of the Association and a resident of Manchester, N.H. He is a student at the Massachusetts Institute of Technology and the son of Clarence E. Ferry, Superintendent of Distribution of the Manchester Water Works. The actual award to Alan E. Ferry, made at the November meeting of the Association in Boston, was filmed by WBZ-TV and shown later on the Arch Macdonald Broadcast. The Scholarship Committee thanks all contributors for their support and makes a special plea for continued financial assistance to this important contribution to the advancement of the water-works profession in New England.

The following contributors are to be added to the list published in the December, 1959, JOURNAL: Red Hed Manufacturing Company, William B. Duffy, Kenneth W. Robie, Peter C. Karalekas, R. H. White Construction Company, and Harold B. Scales.

Respectfully submitted,

(*Signed*) WILLIAM B. DUFFY, *Chairman*
THOMAS R. CAMP, *Vice-Chairman*
RICHARD M. CLEVELAND, *Secretary*
WILLIAM P. MELLEY, *Treasurer*
RICHARD N. BERRY
ROGER W. ESTY
KENNETH F. KNOWLTON

REPORT OF THE COMMITTEE ON COMMITTEES

August 31, 1960

To the New England Water Works Association:

During the past year the Committee on Committees was again composed of the members of the Executive Committee, in order that a close contact might be kept with the activities of the various technical committees.

As a result of the information contained on the questionnaires returned from the committee chairmen, the Committee on Committees recommends that technical committees of the Association be continued as follows:

NEWWA

8 Committee on Legislation
9 Committee on Reciprocal Relations with the Institution of Water Engineers (London)
11 Committee on Survey of Ground Water Supplies in New England
12 Committee on Rainfall and Yield of Drainage Areas
16 Committee on Coefficients for Friction in Pipe Lines
19 Committee on Water Quality and Treatment
21 Committee on Specifications for Cast Iron Pipe and Fittings
22 Committee on Reinforced Concrete Pressure Pipe
23 Committee on Code for Pressure Piping
24 Committee on Laying Cast Iron Pipe
25 Committee on Specifications for Steel Pipe
26 Committee on Standardization of Pipe Flanges and Fittings
28 Committee on Steel Standpipes and Elevated Tanks
30 Committee on Meter Specifications
31 Committee on Hydrant Specifications
32 Committee on Gate Valves
37 Committee on Federal Activities
38 Committee on Fluid Permeability
39 Committee on Deep Well Vertical Pumps
42 Committee on Conservation, Development and Utilization of Water Resources

44 Committee on Publicity
45 Committee on Recreational Uses of Public Water Supplies
46 Committee on Plastic Pipes and Plastic Linings for Water Supply Uses
49 Committee on Water Works Safety Practice
50 Committee on Prestressed Concrete Water Storage Tanks
51 Committee on Standardization of Pressure and Vacuum Gages
52 Committee on Water Rates

The Committee on Committees recommends that *NEWWA 47*—Committee on Methods of Financing Water Main Extensions be discharged, with deep thanks.

During the year a new committee was established to be known as *NEWWA 52*—Committee on Water Rates.

The work of the technical committees is of vital importance to the membership of the Association in the advancement of knowledge relating to water works.

The Committee on Committees appreciates the time and effort given by the technical committees and desires to assist them in every way possible. All suggestions as to the establishment of new committees on subjects which will benefit the members will be very welcome.

Respectfully submitted,

COMMITTEE ON COMMITTEES

REPORT OF COMMITTEE ON LIBRARY

September 15, 1960

To the New England Water Works Association:

The Library Committee is pleased to submit its report for the year ending August 31, 1960.

The Library Committee recommended last year that the approximate sum of $35.00 be made available each year for the annual procurement of books to supplement and update the reference section. As a result of that recommendation, the following books have been purchased and are available in the library:

Title	*Author*
Environmental Sanitation	Salvato
Pump Selection and Application	Hicks
Handbook of Hydraulics	King

The total cost of the above purchases was $31.50.

The Library Committee recommends that the approximate sum of $35.00 be made available again this year for the purchase of books, two of which have been selected:

Applied Hydrology	Linsley, Kohler & Paulhus
Ground Water	Tolman

The trial program, which was initiated last year, of allowing the withdrawal of books from the library for a limited length of time will be continued. An increase in the use of the library was noted following the adoption of this program.

Respectfully submitted,

(*Signed*) SYDNEY C. BEANE, *Chairman*
PAUL C. ROSS
JAMES V. TURNER

REPORT OF COMMITTEE ON RECIPROCAL RELATIONS WITH INSTITUTION OF WATER ENGINEERS (LONDON)

September 19, 1960

To the New England Water Works Association:

Your committee on Reciprocal Relations with the Institution of Water Engineers presents its annual report for 1959.

The Diploma of Merit to an Institution member for an outstanding paper is due to be awarded by the New England Water Works Association in 1961, and your committee has requested from the Institution's Secretary (Mr. Skeat) a list of papers worthy of conside ation for the award.

During last April, Boston was visited by Mr. Andrew G. McLellan, who became President of the Institution the following May. Under the guidance of Mr. Harold Toole, Director of Water Division, and Chief Water Supply Engineer, and Mr. John W. Copithorne, Assistant Engineer of the Metropolitan District Commission, he was shown over the Wachusett, Ware, and Swift River developments of the metropolitan Boston supply. He also was greeted at the Lawrence filter plant by Mr. Nicholas J. Callahan, Water Commissioner, and at the Billerica filter plant by Mr. Thomas Camp, past President of this Association.

Your Chairman has been requested by your Board of Directors to look into the matter of closer relations with the International Water Supply Association (whose Executive Secretary, Mr. Leonard Millis, visited Boston last year), possibly in cooperation with the American Water Works Association.

We wish to report that a committee on International Affairs has been established by the Board of Directors of the American Water Works Association to pursue further the matter of such relations, and that your Chairman is a member of this committee.

Respectfully submitted,

DONALD A. CALDERWOOD
PERCY A. SHAW
E. SHERMAN CHASE, *Chairman*

ANNUAL REPORT OF THE COMMITTEE ON LEGISLATION

September 19, 1960

To the New England Water Works Association:

Your Legislative Committee submits herewith its report on activities in the legislatures of the New England States during the year 1960. Sessions were held in three states—namely, Massachusetts, Rhode Island, and Vermont.

Massachusetts

In Massachusetts, with the General Court still in session and prorogation not yet in sight the following action can be reported:

Chapter 50—"Resolve increasing the scope of the special commission established to make an investigation and study relative to . . ., and the Metropolitan Water Supply System." The commission is specifically directed to make a study of the subject matter of House Bill #37 (proposed major construction and reinforcement of the M. D. C. water distribution system) and House Bill #1391 (proposed increase in the gallonage Southborough may withdraw from the M. D. C. supply works).

Chapter 67—"Resolve providing for an investigation and study by The Water Resources Commission relative to the water supply needs and resources of the municipalities of the county of Essex."

Your committee suggests that interested members obtain a copy, since it is rather lengthy. Report, recommendations and possible legislation due December 1st, in the current year.

Chapter 82—"Resolve providing for a study by the Water Resources Commission of the water resources of the Westfield River Valley."

This chapter briefly outlines the duties and prerogatives of the Commission respecting this study and calls for a final report on or before the 1st Wednesday of January, 1962.

Chapter 45—"Resolve extending the time within which the

Water Resources Commission is required to complete its study and file its final report relative to the water resources of the Ware, Quaboag, and Quinebaug River Valleys."

Completion date extended to 1st Wednesday in December, 1961.

In view of the importance of the provisions of the following enactment it has been deemed advisable to include the measure verbatim.

Chapter 613—"An Act regulating cross connections between public water supplies and other water supplies."

Chapter 111 of the General Laws is hereby amended by inserting after section 160 the following section:—*Section 160A*. No physical cross connection shall be maintained between the distribution system of a public water supply, the water of which is used for drinking, domestic or culinary purposes, and the distribution system of any water supply not approved by the department as being of safe sanitary quality, unless said connection has been approved by the department in accordance with rules and regulations adopted for the purpose, and unless a permit therefor had been issued by the department. Such permit may be issued upon the application of a person maintaining such connection and upon the payment of a fee of ten dollars, and may be renewed annually upon payment of a like fee. When more than one such connection is maintained on any premises a separate permit shall be required for each connection. A permit may be revoked by the department upon due notice to the person maintaining the connection whenever, in the opinion of the department, the connection or the maintenance thereof no longer complies with its rules and regulations, and no portion of the permit fee shall be refunded.

Whoever maintains such a connection without a permit or after revocation of the permit to maintain such a connection shall be punished by a fine of not more than five hundred dollars, to the use of the commonwealth, or by imprisonment for not more than one year, or both.

Chapter 147—"An act further postponing the effective date of the law requiring plans, specifications, plats and reports prepared by professional engineers or land surveyors to be stamped with a seal when filed with public authorities."

This measure enacted in March, and retroactive to January 1st, 1960, postpones until January 1st, 1961, the proposed stamping with a seal.

Rhode Island

Our committee member from Rhode Island reports only two pieces of legislation before the last session of the General Assembly pertaining to water works activities. One was an act to provide for the authority to issue bonds and notes to finance the acquisition of sites for reservoirs for public water supply of the State and in amendment of and in addition to Chapter 46-15 of the General Laws entitled "Water Resources Coordinating Board." Section 1 stated this act shall be known and may be cited as the "Big River-Wood River reservoir site acquisition act." It requested authority to borrow $5,800,000.00 to finance the acquisition by the State of Rhode Island of land for the development of Big River and Wood River Reservoirs.

Big River would be an impounding reservoir and Wood River a diversion reservoir. The estimated safe yield of both reservoirs was 60.5 million gallons daily. The act did not pass the General Assembly.

Another act was introduced to provide for fishing in water supply waters. Section 1 contained the following:

> "Fishing and boating shall not be prohibited in any reservoir which may be constructed in the future in the Wood River basin, so-called, in the Towns of Exeter and West Greenwich and the Big River basin in East Greenwich, West Greenwich, Coventry and Exeter."

This bill passed the Legislature but it was vetoed by the Governor.

Vermont

Legislative action in the State of Vermont during 1959-60 was restricted to reorganizing the administrative branch of the State Government. No legislation related to water supplies was considered.

The 1959 Legislature authorized the State Health Department to make and revise such plumbing rules and regulations as it may deem necessary for the protection of the public health.

These rules and regulations were adopted by the State Health Commission and the Plumber's Examining Board in April this year. The code conforms with the National Plumbing Code.

Respectfully submitted,

HERMAN BURGI, JR.
JOHN W. COSTIGAN
WILLIAM A. HEALY
PHILIP J. HOLTON, JR.
JOHN V. RICHARDS
LARDNER H. SHULL

(*Signed*) MARK F. CROKER, *Chairman*

PROGRESS REPORT OF COMMITTEE ON SPECIFICATIONS FOR CAST-IRON PIPE AND FITTINGS

September, 1960

To the New England Water Works Association:

The Committee on Specifications for Cast-Iron Pipe and Fittings (*NEWWA 21*) is comprised of a single member who serves as NEWWA representative on ASA Sectional Committee A21—Cast-Iron Pipe and Fittings.

One meeting of ASA Sectional Committee A21 was held in New York in November, 1959. This meeting was devoted largely to the consideration of subcommittee reports. The discussion revealed many problems which remain to be solved.

Mr. Clarence E. Ferry, Superintendent of Distribution of the Manchester, New Hampshire, Water Works requested the writer to forward a suggested "transition" type fitting to the committee for consideration. The design was forwarded and referred to the Sub-committee on Fittings.

The Sub-committee on Pipe, of which the writer is Vice-Chairman, held one meeting in University City, Missouri. As a result of this meeting, revised drafts of ASA A21.6, Specification for Cast-Iron Pipe Centrifugally Cast in Metal Molds for Water and Other Liquids, and ASA A21.8, Specification for Cast-Iron Pipe Centrifugally Cast in Sand Lined Molds for Water and Other Liquids, were approved by the sub-committee and forwarded to the Sectional Committee. Action on these revisions will be delayed pending clarification of certain details which are common to other specifications under consideration by other sub-committees.

It appears essential that NEWWA 21 be continued.

Respectfully submitted,

(*Signed*) EDWIN B. COBB, *Chairman*

REPORT OF THE COMMITTEE ON STANDARD SPECIFICATIONS FOR THE INSTALLATION OF CAST-IRON WATER MAINS

September 15, 1960

To the New England Water Works Association:

As no work has been done during the past year by the Committee on Laying Cast-Iron Pipe (joint A.W.W.A.) there is nothing to report.

However, as the A.W.W.A. Committee has not been deactivated and as the Standard Specifications for Installation of Cast-Iron Water Mains (A.W.W.A. C600-54T) are still published as "Tentative," it is recommended that the N.E.W.W.A. Committee be continued pending final adoption of the specifications as standard.

The above report was read to Mr. Mariner over the telephone at his home in New London, New Hampshire, and he concurs with the above recommendation. Accordingly, he asked me to sign for him as Chairman.

Respectfully submitted,

(*Signed*) W. S. MARINER, *Chairman*
GEORGE W. COFFIN

REPORT OF COMMITTEE ON STANDARDIZATION OF PIPE FLANGES AND FITTINGS

September 13, 1960

To the New England Water Works Association:

Your committee No. 26, entitled "Committee on Standardization of Pipe Flanges and Fittings," reports that during the last year it has been in contact with the various subdivisions of the ASA committee B16 having to do with iron and bronze fittings and flanges.

While the bulk of the activity of the ASA committee has to do with other fields than the water-works industry, your committee does review the actions of this committee, so as to keep in touch and thereby protect the interests of the water-works field. At the moment, there is very little activity and nothing which we feel needs action or attention by the water-works people at this particular time.

Respectfully submitted,

(*Signed*) J. P. HENNINGS, *Chairman*
F. J. TURNBULL

REPORT OF COMMITTEE ON ELEVATED TANKS AND STANDPIPES

September 15, 1960

To the New England Water Works Association:

During the past year, your Committee on Elevated Tanks and Standpipes, acting jointly with a similar AWWA Committee, has prepared a draft of the revision of the AWWA Standard D102-55T (Painting and Repainting Steel Tanks, Standpipes, Reservoirs, and Elevated Tanks, for Water Storage). This draft is now under consideration for approval by the Joint Committee. If approved, it will be submitted to the AWWA Water Works Practice Committee and to the NEWWA for recommendations.

The Joint Committee is now considering changes to AWWA D100-59 (Standard for Steel Tanks, Standpipes, Reservoirs, and Elevated Tanks for Water Storage.)

Respectfully submitted,

(*Signed*) GEORGE A. SAMPSON, *Chairman*

REPORT OF COMMITTEE ON HYDRANT SPECIFICATIONS

The Committee has a brief report to make at this time.

As some of you perhaps know, the AWWA Committee on Hydrants was reactivated in the spring. At that time we were charged with the responsibility of reviewing the present AWWA standard, which is also the standard of the New England Water Works Association. The New England Water Works Association has appointed Sam Slicer and myself as representatives on the AWWA committee. Mr. Carl Simon has been appointed to serve as a liaison between this committee and the manufacturers' valve and hydrant specification committee. Up to the present time we have not had a committee meeting, but all members of the committee have been contacted and requested to submit their suggestions for revision by November 15. Mr. Simon has also been requested to do the same thing. At that time we expect to prepare a suitable agenda for the first committee meeting. We believe that with the comments we receive from the members we can proceed very quickly with a revision of this standard.

KENNETH J. CARL

PROGRESS REPORT OF COMMITTEE ON DEEP-WELL VERTICAL PUMPS

September, 1960

To the New England Water Works Association:

The Committee on Deep-Well Vertical Pumps (*NEWWA 39*) is comprised of a single member who serves as NEWWA representative on ASA Committee B-58.

During the past year the Committee completed the final draft of the revisions to the original B-58 Vertical Turbine Pump Standard. This will become Part A of the final standard. Part B covers Submersible Vertical Turbine Pumps and has also been completed. Both these sections have been published in preprint form as a Proposed Revision.

Part C of the above standard will be a Field Test Code. This code is still under preparation by a Task Force. During the past year the writer was asked to fill out a questionnaire titled "Limits of Accuracy of Pump Test Measuring Devices in Field Use." Before answering the questionnaire, comments from representatives of Coffin & Richardson, Inc., Fay, Spofford & Thorndike, Whitman & Howard, and Camp, Dresser & McKee were solicited. Later, a tentative Field Test Report Form was also forwarded to the writer for consideration.

No meeting of the ASA Committee B-58 was held at the AWWA convention, apparently due to the absence of Mr. Marvin H. Owen, the Co-Chairman.

It appears that at least another year will be required to complete the Field Test Code.

Respectfully submitted,

(*Signed*) EDWIN B. COBB, *Chairman*

REPORT OF THE COMMITTEE ON CONSERVATION, DEVELOPMENT AND UTILIZATION OF WATER RESOURCES

September 19, 1960

To the New England Water Works Association:

The tremendous interest in the water resources of the Nation continues at both the State and Federal levels. Water resource matters play a major role in the legislatures of the New England States, and the State agencies which administer the laws relating thereto are developing, in cooperation with similar Federal agencies, comprehensive plans and programs for the conservation and development of their water resources.

Reference has previously been made to the Northeastern Resources Committee, composed of representatives of the Federal agencies concerned with natural resources and of the New England States. This Committee was established in 1957 to implement the report of the New England-New York Inter-Agency Committee and to coordinate the development of the resources of the region. A compact proposed by NRC for the creation of a permanent Northeastern Resources Commission, consisting of a representative of each State and each Federal agency, has been ratified by Connecticut, Rhode Island, New Hampshire and Massachusetts. A bill granting Congressional consent to the compact was not acted upon by the 86th Congress and will probably be reintroduced into the 87th Congress when it convenes next January.

New England is experiencing an unprecedented "clean-streams" program as a necessary, valuable and economical supplement to other conservation measures. The pollution control programs of the States are being coordinated through the New England Interstate Water Pollution Control Commission. Since 1956 there have been 93 sewage treatment projects for New England, estimated to cost $50 million, approved for Federal construction grants under Public Law 660. Twenty-nine of the projects have been completed and 41 are under construction.

In this connection legislation to double the appropriation for such grants was vetoed by President Eisenhower, but will be introduced into the 87th Congress.

A year ago it was reported that the 86th Congress had passed Senate Resolution 48, establishing the Senate Select Committee on National Water Resources. The Committee has held 23 public hearings in various sections of the country and at the Boston hearing NEWWA's President Gentner presented a statement on behalf of the Association. As the first step in its study of the Nation's water resources problems, the Committee has published 31 reports, containing available information relating to various phases of water resources.

The Water and Sewage Works Manufacturers Association has under way a public relations program to inform the American voters of the necessity of constructing and enlarging water and sewerage facilities. The program is being carried out through newspapers, magazines, radio and television, special publications and films. The motion picture, "Pennies for Health," which is being shown at this convention is an integral part of this educational program. Various associations and agencies concerned with water supply and pollution control matters are considering the possibility of sponsoring an exhibit at the 1965 World's Fair in New York to stress publicly the importance of water resources in our daily lives.

As developments arise in the water-resources field, your committee will continue to advise the membership of NEWWA in order that appropriate action may be taken where policy formulation and legislation are involved.

Respectfully submitted,

WALTER J. SHEA
JOSEPH C. KNOX
HARRY MANSON, *Chairman*

REPORT OF COMMITTEE ON WATER-WORKS SAFETY PRACTICE

To the New England Water Works Association:

As in the past the Committee on Water-Works Safety Practice has contacted all of the water utilities in New England, which are represented in the American Water Works Association, for the purpose of obtaining safety records, to establish which such agencies were eligible for Safety Awards of the A. W. W A. A total of 87 questionnaires were distributed to encompass the safety record for 1959, 30 were returned, and 16 of those submitted were entitled to Safety Awards. The awards were presented March 17, 1960, at the Statler Hotel in Boston and were based on the number of lost-time injuries, man-hours worked, and the number of employees.

A history from 1956 through 1959 for those agencies that received awards is presented in the tabulation appended.

It is interesting to note that the Average Frequency Rate of the agencies that participated is 38.7 as compared to the National Average of 1958 which is 8.7. The New England Section Frequency Rate for 1958 was 4.8 as compared to the 1959 rate of 38.7.

Unfortunately the record for 1959 is not as good as it might have been and this committee strongly urges that at least one superintendents' or chemists' "Round Table" discussion during the coming year be devoted to Water-Works Safety Practices and every effort be expended to arouse more interest in the Safety Award Program and thereby improve our Safety Record.

On the basis of the results submitted, this committee made the following nominations to the American Water Works Association for the Wendell R. Ladue Award:

Class #1—Hampton Water Works Company, New Hampshire.

Class #2—Town of Brookline Water Dept., Massachusetts

Class #3—Bridgeport Hydraulic Company, Connecticut

Respectfully submitted,

(*Signed*) KENNETH E. BENDER, *Chairman*
HERMAN BURGI, JR.
MARK CROKER
JUSTIN HOLDEN
PHILIP HOLTON
RALPH SOULE
JAMES SWEENEY

Agency	Year	No. of lost-time injuries	No. of days lost—injuries	Permanent disabilities	Fatal injuries	Average no. of employees	Man-hours worked	Injury-frequency rate	Remarks
Connecticut									
Bridgeport Hydraulic Co.	1956	21	289	0	0	296	592,000	35.5	
Bridgeport, Conn.	1957	3	152	0	0	267	565,360	5.3	Award of Honor
	1958	9	129	0	0	238	476,000	21.0	
	1959	2	99	0	0	220	437,750	4.6	Award of Honor
The Ansonia Water Company	1956	1	0						
Ansonia, Conn.	1957	1	40						
	1958	1	43						
	1959	0	5	0	0	14	24,568	0	Award of Merit
Waterbury—Bureau of Water	1956	0	0						
Waterbury, Conn.	1957	2	36						
	1958	3	78	1	0	60	134,680	22.3	
	1959	1	42	0	0	66	140,900	7.09	Award of Honor
The Noroton Water Co.	1956	0	0						
Darien, Conn.	1957	0	0						
	1958	1	4	0	0	7	15,600	64.	
	1959	0	0	0	0	6	15,700	0.	Award of Merit
Greenwich Water Co.	1956	0	0						
Greenwich, Conn.	1957	2	2						
	1958	3	28	0	0	46	105,194	28.5	
	1959	1	2	0	0	45	96,998	10.3	Award of Progress
New Canaan Water Co.	1956	0	0						
New Canaan, Conn.	1957	0	0						
	1958	0	0						
	1959	0	0	0	0	4	8,960	0	Award of Merit

Agency	Year	No. of lost-time injuries	No. of days lost—injuries	Permanent disabilities	Fatal injuries	Average no. of employees	Man-hours worked	Injury-frequency rate	Remarks
Maine									
Bangor Water District	1956	6	126	0	0	44	99,216	60.5	
	1957	2	3						
	1958	8	145						
	1959	5	12	0	0	41	90,200	55	Award of Progress
Bath Water District	1956	0	0	0	0				
	1957	0	0	0	0				
	1958	0	0	0	0	16.4	32,800	0	Award of Merit
	1959	0	0	0	0	16.85	33,700	0	Award of Honor
Winthrop Water District	1956	0	0	0	0				
	1957	0	0	0	0				
	1958	0	0	0	0	3	8,000	0	Award of Merit
	1959	0	0	0	0	3.16	7,336	0	Award of Merit
Massachusetts									
Town of Brookline Water Department	1956	0	0						
	1957	1	107						
	1958	0	239	0	0	52	110,000	0	Award of Honor
	1959	0	230	0	0	54	108,000	0	Award of Honor
Salem & Beverly Water Supply Board	1956								
	1957	1	4						
	1958	1	10	0	0	10.94	21,880	182	
	1959	0	0	0	0	11	22,000	0	Award of Merit
Salisbury Water Supply Co.	1956	1	7						
	1957	0	0						

Agency	Year	No. of lost-time injuries	No. of days lost—injuries	Permanent disabilities	Fatal injuries	Average no. of employees	Man-hours worked	Injury-frequency rate	Remarks
Massachusetts (cont.)									
Salisbury Water Supply Co. (*cont.*)	1958	1	18	0	0	4.5	9,180	109	
	1959	0	0	0	0	4.4	8,848	0	Award of Merit
Wannacomet Water Company	1956	2	61						
	1957	0	0						
	1958	0	0	0	0	13.4	26,721	0	Award of Merit
	1959	0	0	0	0	12.8	25,673	0	Award of Merit
New Hampshire									
The Hampton Water Works Company	1956	0	0						
	1957	0	0						
	1958	0	0	0	0	9	20,587	0	Award of Merit
	1959	0	0	0	0	9	20,840	0	Award of Merit
Rhode Island									
Westerly Water Department	1956	0	0	0	0	29	60,320		
	1957	0	0	0	0				
	1958	0	0	0	0	31	62,000	0	Award of Merit
	1959	0	0	0	0	29	58,000	0	Award of Honor
Vermont									
City of Montpelier Water Department	1956	3	6						
	1957	1	2						
	1958	0	0						
	1959	0	0	0	0	10	15,500	0	Award of Merit

PROGRESS REPORT OF COMMITTEE ON SPECIFICATIONS FOR PRESTRESSED CONCRETE WATER-STORAGE TANKS

September, 1960

To the New England Water Works Association:

The Committee on Specifications for Prestressed Concrete Water-Storage Tanks (*NEWWA-50*) held but one meeting during the past year. A second meeting was planned but up to now a suitable date has not been found.

Committee Member of O'Neil has completed the field inspection of prestressed concrete water-storage tanks in New England His pictures of the tanks inspected and his notes have been compiled in suitable form for future publication.

Committee members have submitted copies of specifications used by their respective offices. These will be used for comparison with the specification prepared by the committee.

An initial draft of a specification has been prepared and is under consideration by committee members. Considerable work remains to be done, however, before this draft can be considered complete.

At least another year will be required before this committee can complete its assignment.

Respectfully submitted,

(*Signed*) EDWIN B. COBB, *Chairman*

REPORT OF COMMITTEE ON WATER RATES

September 16, 1960

To the New England Water Works Association:

The Committee on Water Rates was appointed by the Association in October, 1959.

The Committee has selected as its initial activity the compilation of basic water-rate data of public water supply agencies in New England. A data form has been drafted which will facilitate the ready comparison of rate structure.

It is anticipated that preliminary collection of water-rate data in New England will be undertaken early in 1961.

Respectfully,

(*Signed*) HYMAN J. STEINHURST, *Chairman*
JOHN C. CLIFFORD
FRANK J. LARIVIERE
RICHARD F. MASON
JOHN V. RICHARDS
RICHARD S. WARNER

PROGRESS REPORT OF NEWWA REPRESENTATIVES ON JOINT AWWA-NEWWA COMMITTEE ON METERS

September 19, 1960

Subsequent to the completion of the Meter Manual referred to in the NEWWA Committee Chairman's report to the Association in September, 1959, this committee has undertaken a revision of the "Standards for Cold-Water Meters—Displacement Type."

A draft of these specifications, dated June 30, 1960, incorporating changes and suggestions discussed at the committee meeting held in May at Miami, was submitted to the committee members for approval or rejection. In the event of favorable action by the committee, this draft will be submitted to the AWWA Board of Directors for action at its meeting in January, 1961.

It is suggested that no action be taken by the NEWWA toward the approval or publication of this Standard until after its approval by the AWWA.

Respectfully submitted for the Committee,
(*Signed*) RICHARD H. ELLIS

REPORT OF NEWWA REPRESENTATIVES ON AWWA-NEWWA COMMITTEE C500 ON GATE VALVES FOR ORDINARY WATER-WORKS SERVICE

September 19, 1960

On September 21, 1959, the NEWWA representatives on the joint AWWA-NEWWA Committee C500 on Gate Valves recommended that NEWWA approval of the 1959 Tentative Standards for Gate Valves for Ordinary Water-Works Service be withheld pending action on further revisions then under consideration.

As a meeting of the Joint Committee held May 17, 1960, at Miami, Florida, the committee reviewed the suggested revisions and voted to accept some of the suggestions, reject others, and to refer some to the Manufacturers Committee for its comments. No further committee action has been taken to date.

Your representatives, therefore, recommend that no action be taken at this time by this Association toward approval or publication of the present Tentative Standard for Gate Valves for Ordinary Water-Works Service.

Respectfully submitted,

(*Signed*) RICHARD H. ELLIS
J. SAMUEL SLICER, JR.

REPORT OF COMMITTEE ON PLASTIC PIPE

This is a report of Committee 46 on Plastic Pipe. We have very little to report, actually, this year, but have been considering very strongly the necessity for amplifying this existing committee. We have had standards on practically every other type of pipe. We have very few varieties of cast-iron and steel pipe, but there are eighteen hundred varieties of plastic pipe, so that I think standardization may be an important job.

I would particularly like to have the Association consider the addition of plastic pipe to our job. I would also suggest that an older man be at the top to take care of the thing as I figure I am much too young to be chairman of the committee much longer.

We have, as already reported, been doing work at the Experiment Station a great deal on plastic pipe and have many results which will be ready for publication in about two years.

I would very much like to have the Association consider the setting up of at least three committees, one of which would be a committee on general standards for plastic pipe; another a committee on the use of plastic pipe in water for domestic use; and a third one—I don't know how to set it up, but to meet the demands we are getting from the local people, the plumbing inspectors, and so on, as to how they shall be able to satisfy themselves.

We already have in the sewage works association the conditions on use of plastic pipe in that field.

JOSEPH A. MCCARTHY

REPORT OF COMMITTEE ON REINFORCED-CONCRETE PIPE

I did not intend that there should be any formal report, because we have had no meeting of this committee, but I do not like to leave the void which might exist if I did not comment that this committee had not been active.

As you know, this committee is joint with the American Water Works Association, and there have been two specifications before that committee for review this past year. The first one is on the laying of reinforced-concrete pipe, and that was reviewed separately by the members of that committee, although there was no committee meeting. The committee reported in Bal Harbour, Florida, with the AWWA committee when these specifications were discussed.

There is a second set of specifications on prestressed reinforced-concrete pipe which is now being reviewed.

STANLEY M. DORE

COMMITTEES OF THE NEW ENGLAND WATER WORKS ASSOCIATION, 1960-1961

NEWWA

1. *Committee on Technical Programs:* I. Laird Newell, *Chairman,* John C. Adams, Jr., G. Arthur Faneuf, Albert S. Genaske, Clifton E. Hodgdon, George C. Houser, John W. Hughes, E. Boyd Livesay, James J. Matera, Alexander J. Minkus, William H. McGinness, Lorrin M. Pittendreigh, John V. Richards, Darrell A. Root, Ernest A. Snow, Jr., and Ralph M. Soule.
2. *Committee on Northern New England Meeting*: Kenneth F. Knowlton.
3. *Committee on Southern New England Meeting:* Warren A. Gentner.
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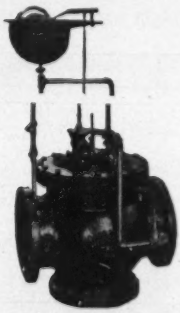

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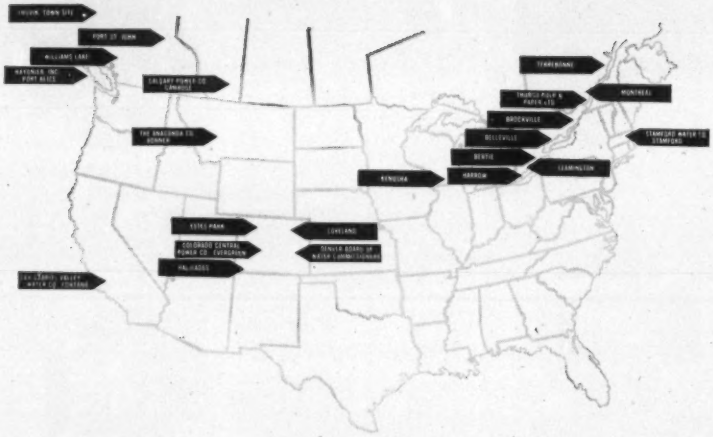

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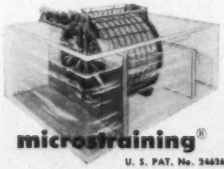

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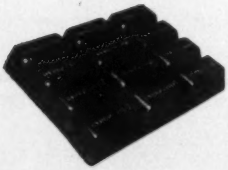

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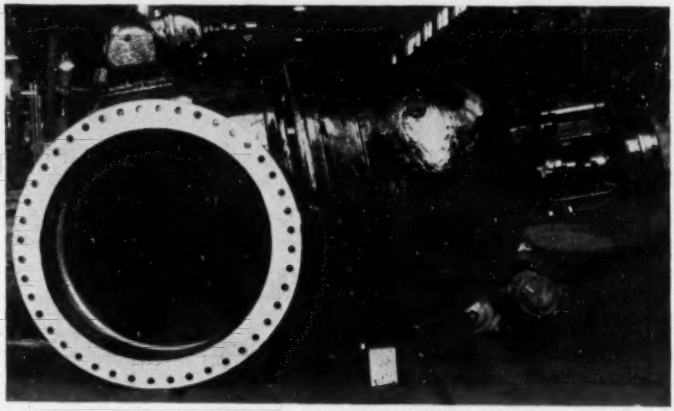

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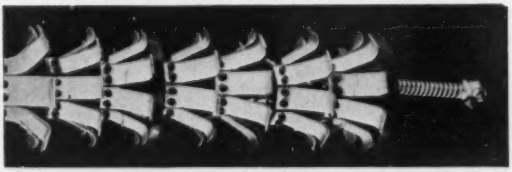

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Cost charges for installing mains and services. Committee report. lxvi 424, 1952.
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Determination of water rate schedules. Committee report. lxviii., Dec 1954.
Financing water-works construction in New England. (W. P. Coues) lxxiv 161, 1960.
Method of financing water main extensions. Committee report lxviii 358, 1954.
Methods of financing water main extensions. Interim Committee report lxix 230, 1955.
Methods of financing water main extensions. Committee report lxx 432, 1956.
Water rate schedules. Committee report. lxvi 419, 1952; lxvii 302, 1953; lxviii 351, 1954; lxxiv 373, 1960.

FIRES, FIRE PREVENTION AND SUPLIES.

Determination of charges for public fire protection. (D. A. Root and T. R. Camp) lxix 90, 1955.

Determination of charges for public fire protection. (D. A. Root and T. R. Camp) lxx 199, 1956.
Determination of charges for public fire protection. (Louis E. Ayres) (discussion) lxx 199, 1956.
Elements of an emergency water system for fire service. (J. C. Adams, Jr.) lxx 311, 1956.
Experience in Manchester, Mass., during forest fires. (A. S. Doane) lxxii 22, 1958.
Water for wartime fire protection. (H. Bond) lxxi 17, 1957.
See also HYDRANTS.
FLOODS. See HYDROLOGY.
FLUORIDES. See HEALTH, HYGIENE, EPIDEMIOLOGY.
FLUSHING. See PIPES (CLEANING).
FOUNDATIONS. See DAMS.
FORESTATION. See WATERSHEDS.
FREEZING AND FROST PROTECTION. See ICE, HYDRANTS, MAINTENANCE and PIPE.
FRICTION LOSSES. See HYDRAULICS.
FUEL. See PUMPING.
GATES, VALVES.
Present day uses of cone valve. (C. J. Wilcox) lxv 249, 1951.
Use of butterfly valves on water distribution system. (A. E. Hatch, Jr.) lxxiv 22, 1960.
GEOLOGY.
Depth determination from Seismic data (R. L. Geyer) lxv 185, 1951.
The geohydrology of New England. (Rev. D. Linehan, S. J.) lxxii 149, 1958.
GROUND WATER, WELLS, FILTER GALLERIES.
Geologic factors affecting the yield of rock wells in southern New England. (R. V. Cushman, W. B. Allen and H. L. Pree, Jr.) lxvii 77, 1955.
Ground water studies in Rhode Island (W. B. Allen) lxvii 96, 1953.
Ground water supply for New Britain, Conn. (G. W. Wood) lxv 143, 1951.
Ground water supplies in New England. Committee report. lxv 384, 1951; lxvii 304, 1953; lxx 383, 1956; lxxi 55, 1957.
New and interesting features in relation to gravel packed wells and pumping plants at Provincetown and Centerville-Osterville, Mass. (P. F. Howard) lxix 301, 1955.
Occurrence of water in buried valley deposits. (D. W. Miller) lxxiii 124, 1959.
Public ground water supplies. Maine Committee report lxxi 56, 1957.
Public ground water supplies—New Hampshire. Committee report lxxi 62, 1957.
Public ground water supplies—Vermont. Committee report lxxi 76, 1957.
Public ground water supplies—Rhode Island. Committee report lxxi 70, 1957.
Survey of ground water supplies in New England. Committee report lxvi 399, 1952.
Technical investigations of additional ground water supplies in Rhode Island. (W. B. Allen) lxv 211, 1951.
The case for a positive well field maintenance program. (E. B. Livesay) lxx 292, 1956.
The development of a large well supply. (F. R. Silliman) lxviii 158, 1954.
GROUNDING. See CORROSION AND ELECTROLYSIS.
GROUTING AND GUNITING. See AQUEDUCTS, DAMS, RESERVOIRS.
HEALTH, HYGIENE, EPIDEMIOLOGY.
Actual trends in sanitary engineering and water supply in Europe. (W. F. J. M. Krul) lxxii 160, 1958.
An approach to water supply toxicology (B. C. Nesin) lxx 172, 1956.
A rapid method for the determination of fluorides in water supplies. (L. Rubin) lxvi 97, 1952.
Experiences in the application of fluorides to public water supplies in Northeastern Massachusetts (H. D. Nickerson) lxxiv 202, 1960.
Fluoridation experience in New Britain. (G. W. Wood) lxvi 82, 1952.
Fundamentals of water fluoridation (H. A. Faber) lxvi 66, 1952.
Progress and experience with fluoridation in Connecticut (W. J. Scott) lxvi 87, 1952.
Radiation experiences in Massachusetts water supplies. (R. M. Soule) lxix 181, 1955.
The optimum vehicle for fluoridation—water or milk? (J. E. McKee) lxvii 9, 1953.
Water in public health. (S. B. Kirkwood, M.D.) lxix 144, 1955.
HISTORICAL.
New England's contribution to the water works profession. (E. S. Chase) lxxii 88, 1958.
HOSE. See FIRES, etc.
HOT WATER BOILERS. see PLUMBING.
HYDRANTS. See FIRES.
HYDRAULICS.
Coefficients for friction in pipe lines. Committee report. lxviii 342, 1954; lxxi 52, 1957; lxxii 399, 1958.
Deterioration of the hydraulic capacity of pipe lines. (A. J. Minkus) lxviii 1, 1954.
Fluid permeability. Committee report. lxv 398, 1951; lxvi 418, 1952; lxvii 313, 1953.
Pressure and volume survey in Arlington, Mass. (F. N. O'Hara) lxxi 188, 1957.
Realistic limitations of flow-measurement rangeability and tolerance. (L. K. Spink and R. C. Tamm) lxx 53, 1956.
Simple field methods for finding fire flow and pipe friction. (J. C. Adams, Jr.) lxix 207, 1955.
Simplified analysis of complex waterworks distribution networks. (E. B. Cobb) lxxiii 275, 1959.
The analysis of complex waterworks distribution networks. (Edwin B. Cobb) lxx 29, 1956.
Use of McIlroy fluid network analyzer in Philadelphia (V. A. Appleyard) lxxi 139, 1957.
Water distribution systems studied by a complete electrical analogy. (M. S. McIlroy) lxv 299, 1951.
See also LABORATORIES.
HYDROLOGY.
Control of New England floods. (R. J. Fleming, Jr.) lxxi 234, 1957.
Experiences with public water supply damage in the Connecticut flood disaster of 1955. (W. J. Scott) lxx 275, 1956.
Hurricane experiences, 1954. (P. T. Anderson) lxix 255, 1955.
Obstacles encountered at plants of Bristol Water Co., during hurricanes "Carol" and "Edna." (F. P. Stradling) lxix 236, 1955.
Rainfall and yield of drainage areas. Committee report lxv 388, 1951.
Rainfall and yield of drainage areas. Committee report lxvii 307, 1953.
Rainfall and yield of drainage areas. Rainfall in Massachusetts Part 1 lxviii 39, 1954.

Rainfall and yield of drainage areas Part 2. Rainfall, Maine. Committee report lxix 403, 1955.
Rainfall and yield of drainage areas. Committee report. Part 3. Rainfall in New Hampshire lxx 91, 1956. Rainfall in New England.
Rainfall in New England Part 4. Rainfall in Vermont lxx 216, 1956.
Rainfall and yield of drainage areas. Rainfall in New England Part 5. Rainfall in Rhode Island. Committee report lxx 340, 1956.
Rainfall and yield of drainage areas. Committee report. Rainfall in New England. Part 6. Rainfall in Connecticut lxxi 82, 1957.
Rainfall and yield of drainage areas. Rainfall in New England. Part 6. Rainfall in Connecticut (cont.). Committee report lxxi 150, 1957.
Survey of ground water supplies in New England. Committee Report lxix 386, 1955.
Weather cycles and rainfall (R. L. Hendrick) lxxiii 267, 1959.

ICE AND THAWING. See HYDRANTS.
INDUSTRIAL WASTES. See QUALITY also SEWAGE.
INFILTRATION GALLERIES. See GROUND WATER.
INTAKES.
Portland's new Sebago Lake intake and supply conduit. (H. Burgi, Jr.) lxviii 191, 1954.
IRON REMOVAL. See TREATMENT.
JOINTS AND JOINTING MATERIALS. See PIPES (JOINTS).
LABORATORIES. See DESCRIPTIONS.
LEAKAGE, WASTE AND BREAKS. See SUPPLY.
LEAD AND HEALTH. See HEALTH.
LEGAL, DAMAGES.
Legislation. Committee report. lxv 372, 1951; lxvi 390, 1952; lxvii 294, 1953; lxviii 336, 1954; lxix 377, 1955; lxx 377, 1956; lxxi 368, 1957; lxxii 395, 1958; lxxiv 355, 1960.
LINING PIPE. See PIPE AND LINES (LINING).
MANAGEMENT ORGANIZATION.
Do you buy "price or "value"? (Dr. M. M. Cohn) lxxii 81, 1958.
Engineering and operation of the water system. (P. C. Karalekas) lxxiii 202, 1959.
Experiences in operation of a small water department. (F. E. Colby) lxvi 199, 1952.
Functions of the sanitary engineering division of the State Dept. of Health. (W. A. Healy and Francis J. Lariviere) lxxi 44, 1957.
How supervisory control can help New England water systems. (B. L. Soscia) lxxiii 89, 1959.
Management and the water industry. (F. H. Bullock) lxxii 221, 1958.
Municipal administration and finance. (E. C. Monahan) lxxii 1, 1958.
National roster of sanitary and public health engineers. (F. B. Elder) lxv 94, 1951.
Office procedure. (M. F. Croker) lxxiii 191, 1959.
Recruiting for water works. (J. H. Murdoch, Jr.) lxix 153, 1955.
Water department planning. (C. E. Ferry) lxxiv 35, 1960.
Water works safety practice. (Committee report) lxxii 417, 1958; lxxiii 388, 1959; lxxiv 367, 1960.

MAINTENANCE. See MANAGEMENT AND ORGANIZATION.
MANGANESE REMOVAL. See TREATMENT.
MANHOLE FRAMES AND COVERS. See SPECIFICATIONS.
MEASUREMENT OF WATER. See HYDRAULICS.
METEOROLOGY. See HYDROLOGY.
METERS AND METERING.
History and operating principles of the magnetic flow meter. (R. H. Babcock) lxxi 243, 1957.
Use of the magnetic flow meter at Medfield, Mass. (E. B. Cobb) lxxi 251, 1957.
Water meters. (J. A. Sweeney) lxv 159, 1951.
MICROSCOPIC ORGANISMS. See QUALITY also TREATMENT.
MILITARY SUPPLIES. See SUPPLY (MILITARY).
MISCELLANEOUS.
How good is New England as a location for manufacturing? (A. A. Bright, Jr.) lxv 163, 1951.
Proposed New England steel mill. (R. M. Hudson) lxv 103, 1951.
The ever-lengthening shadow. (R. M. Binney) lxvi 313, 1952.
MONEL METAL. See CORROSION.
MOTORS. See PUMPS also WATERPOWER.
OZONE. See TREATMENT (DISINFECTION).
PAINTING STANDPIPES. See TANKS also SPECIFICATIONS.
PERSONNEL, ADMINISTRATION. See MANAGEMENT.
PIPE, PIPE LINES.
GENERAL:
Bridge crossings. (G. A. Howland, III) lxvi 343, 1952.
Engineering and design problems in connection with access highway utility relocations. (K. E. Bender) lxxii 12, 1958.
Laying cast iron water mains. (Committee report) lxv 392, 1951.
Progress report on laying cast iron water mains. (Committee report) lxvi 409, 1952.
CLEANING AND DISINFECTING:
Maintaining pipeline coefficient "C" after water main cleaning. (W. D. Monie and H. B. Scales) lxxi 203, 1957.
Pressure tool cleaning versus chair head cleaning. (R. F. Bahr, Jr.) lxxii 298, 1958.
CONCRETE:
Reinforced concrete pressure pipe. (Committee report) lxvi 408, 1952.
JOINTS:
Mechanical-joint cast iron pipe. (T. S. Wolfe) lxix 278, 1955.
LINING AND COATING:
Re-lining of water mains in Situ. (Alan Atkinson) lxx iii, 1956.
Special uses of cement-lined pipe of large size. (W. A. Arnold) lxxiv 57, 1960.
PLASTIC PIPE:
Experience with plastic service pipe. (A. M. Symonds) lxviii 217, 1954.
Manufacture of plastic pipe. (B. Britton) lxviii 211, 1954.
Plastic pipe and plastic linings for water supply uses. (Committee report) lxxi 385, 1957; lxxii 416, 1958; lxxiii 387, 1959; lxxiv 376, 1960.
SUBMARINE:
Laying subaqueous pressure mains. (S. Haseltine) lxvi 10, 1952.
PIPE LAYING. See PIPE AND PIPE LINES.
PIPE TAPPING. See PIPES (JOINTS).

PITOMETERS AND PITOT TUBES. See HYDRAULICS.
PLUMBING.
Cross connections with heating systems containing corrosion inhibitors. (F. J. Lariviere) lxxii 350, 1958.
Recent surveys in Connecticut of water piping within buildings. (C. H. Lawrance) lxvi 26, 1952.
POLLUTION. See QUALITY.
PRECIPITATION. See HYDROLOGY.
PRESSURE REGULATORS. See GATES, VALVES.
PRIVATE WATER WORKS. See MANAGEMENT also FINANCING.
PROTECTION OF WATER SUPPLY. See HEALTH, QUALITY, LEGAL.
PUBLIC HEALTH. See HEALTH.
PUBLIC RELATIONS.
Publicity and public relations. (Committee report) lxxi 383, 1957.
PUMPING.
GENERAL:
How the Taunton pumping station was modernized. (F. J. Turnbull) lxxi 296, 1957.
Pumping problems in Worcester, Mass. (C. B. Hardy) lxxiii 23, 1959.
Pumps and pumping stations. (R. Hazen) lxvii 114, 1953.
The Hudson River pumping plant of the City of New York. (T. Eide) lxvii 245, 1953.
ELECTRICAL:
Application and operation of the submersible motor and pump. (J. E. Hawks) lxxi 104, 1957.
Improvements to pumping and filtration facilities at Cambridge filter plant. (T. R. Camp) lxviii 135, 1954.
Improvements to the New Bedford Water System. (H. C. Mandell) lxix 269, 1955.
Maintenance has a fourth dimension. (L. T. Jester, Jr.) lxix 168, 1955.
Maintenance of motors and control. (W. Hansen) lxix 177, 1955.
Maintenance of power-distribution equipment. (A. H. Ruling, Jr.) lxix 173, 1955.
The Barrington station of Bristol County Water Co., R. I. (D. F. Bixler and C. E. Trowbridge) lxix 140, 1955.
PURIFICATION. See TREATMENT AND PURIFICATION.
QUALITY.
GENERAL:
Continuing research related to water and sewage treatment. (H. V. Moss) lxxi 284, 1957.
Irrigation water quality of the New York-New England region. (J. A. Creatura) lxxiv 151, 1960.
Oxygen demand exerted by leaves stored under water. (E. S. Chase and A. F. Ferullo) lxxi 307, 1957.
Quality control of water in the Springfield system. (J. P. Lynch) lxviii 174, 1954.
Recreational use of public water supplies. (Committee report) lxvii 321, 1953.
Sanitary supervision of Maine water supplies. (H. H. Potter) lxvi 190, 1952.
Significance of radioactivity to water works superintendents. (R. Eliassen) lxvi 260, 1952.
Synthetic detergents and public water supplies. (C. N. Sawyer and D. W. Ryckman) lxxi 261, 1957.
The new gas transmission lines in Massachusetts in relation to public water supplies. (R. M. Soule) lxvi 228, 1952.
AQUATIC GROWTHS:
Algae and other interference organisms in New England water supplies. (C. M. Palmer) lxxii 27, 1958.
Review of microorganisms in water supplies. (S. O. Swartz) lxix 217, 1955.
The most troublesome algae in New England waters. (E. A. Snow, Jr.) lxxii 328, 1958.
BACTERIOLOGICAL:
Bacteriology in the treatment and laboratory control of public water supplies. (J. J. Collins, Jr.) lxvi 253, 1952.
Limitations of standard bacteriologic methods in evaluating sanitary quality of water. (F. W. Gilcrease) lxvi 167, 1952.
CHEMICAL AND PHYSICAL:
Contamination of ground water by synthetic detergents. (I. L. Newell and F. O. A. Almquist) lxxiv 61, 1960.
Mineral characteristics of Maine public water supplies. (R. W. MacDonald) lxviii 204, 1954.
Tastes and odors in Connecticut water supplies. (R. S. Woodhull) lxix 126, 1955.
Taste and odor problems in the United States. (E. A. Sigworth) lxxiii 224, 1959.
POLLUTION, PROTECTION AND CONTROL:
Domestic and industrial water supplies face the pollution problem. (M. Pirnie) lxviii, 250, 1954.
Functions, duties and authorities of the public health service on water pollution control. (L. W. Trager) lxv 119, 1951.
Sanitary protection of surface water supplies. (W. A. Healy) lxvi 214, 1952.
Significance of the coliform test in relation to intestinal virus pollution of water. (F. W. Gilcreas and S. M. Kelly) lxviii 255, 1954.
Water supply control in retrospect—a brief review. (C. R. Cox) lxvi 290, 1952).
QUICKSAND. See PIPE LINES.
RATES. See FINANCING.
RAINFALL. See HYDROLOGY.
RECORDS. See ACCOUNTING.
RECREATION FACILITIES. See WATERSHEDS.
RED WATER. See CORROSION.
REGULATIONS OF PUBLIC UTILITIES. See MANAGEMENT.
REGULATIONS. See MANAGEMENT.
REGULATORS. See GATES, VALVES.
RELIEF VALVES. See GATES, VALVES.
RESERVOIRS.
GENERAL:
New distribution reservoir at Taunton. (F. M. Cahaly) lxxi 302, 1957.
Removal of reservoir debris while maintaining water service. (P. C. Karalekas and C. A. Manganaro) lxxiv 259, 1960.
DISTRIBUTING:
New asphalt lined reservoir for Rutland, Vt. (E. L. Tracy) lxix 314, 1955.
Wickham Hill storage reservoirs. (W. Dorenbaum) lxv 173, 1951.
See also DESCRIPTION OF VARIOUS WATER SYSTEMS AND SUPPLIES.
REVENUE. See MANAGEMENT and FINANCING.
RUN-OFF. See HYDROLOGY.
SALT WATER SUPPLIES. See FIRES.
SANITATION. See HEALTH and QUALITY.
SEDIMENTATION. See TREATMENT.
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SERVICE PIPES AND EQUIPMENT. See PIPE—PIPE LINES.
SEWAGE AND WASTE DISPOSAL. See HEALTH, TREATMENT.
SINKING FUNDS. See FINANCING.

SIPHONS. See PIPES.
SNOWFALL. See HYDROLOGY.
Odors and taste in public water supplies. (D. H. Turcotte). lxviii 181, 1954.
SOFTENING. See TREATMENT (SOFTENING).
SOIL CORROSION. See CORROSION.
SOURCES OF SUPPLY. See GROUND WATER, SUPPLY, DESCRIPTION, WATERSHEDS.
SPECIFICATIONS AND STANDARDS.
American standard specifications for cast iron pipe centrifugally cast in metal molds, for water or other liquids. (A. W. W. A.) lxvii Sept. appended, 1953.
American standard specifications for cast iron pipe centrifugally cast in sand lined molds, for water or other liquids. (A. W. W. A.) lxvii Sept. appended 1953.
American standard specifications for deep well vertical turbine pumps. (A. W. W. A.) lxix Dec. appended, 1955.
American standard specifications for a mechanical joint for cast iron pressure pipe and fittings. (A. W. W. A.) lxvii June appended, 1953.
American standard specifications for short-body cast iron fittings, 3" to 12", for 250-psi water pressure plus water hammer. lxvii March appended, 1953.
A. W. W. A. standard specifications for coal-tar enamel protective coatings for steel water pipe. lxxii Mar. appended, 1958.
Code for pressure piping. (Committee report) lxx 423, 1956.
Current specifications for cast iron pipe and how to order to specifications. (T. W. Wolfe) lxxi 130, 1957.
Deep well vertical pumps. (Committee report) lxxii 405, 1958; lxiii 384, 1959; lxxiv 364, 1960.
Gate valves for ordinary water works service. (Committee report) lxxiii 383, 1959.
Gate valve specifications. (Committee report) lxv 396, 1951; lxvi 413, 1952.
Hydrant specifications. (Committee report) lxv 395, 1951; lxvi 412, 1952; lxxiv 363, 1960.
Laying cast iron pipe. (Committee report) lxxi 376, 1957.
Laying cast iron water mains. (Committee report) lxvii 310, 1953; lxx 424, 1956.
Meter specifications. (Committee report) lxxiii 382, 1959.
Progress report of N. E. W. W. A. representatives on joint A. W. W. A.-N. E. W. W. A. committee on meters. (Committe report) lxxiv 374, 1960.
Progress report on deep well vertical pumps. (Committee report) lxviii 350, 1954.
Progress report of committee on deep-well vertical turbine pumps. (Committee report) lxix 397, 1955.
Progress report on laying cast iron water mains. (Committee report) lxviii 347, 1954.
Reinforced concrete pressure pipe. (Committee report) lxv 390, 1951; lxvii 309, 1953; lxviii 346, 1954; lxxiv 377, 1960.
Report of N. E. W. W. A. representative on A. W. W. A.-N. E. W. W. A. committee C500 on gate valves for ordinary water works service. lxxiv 375, 1960.
Revisions to steel water tank standards. lxvi appended, 1952.
Sluice gate specifications. (Committee report) lxv 397, 1951.
Specifications for cast iron pipe and fittings. (Committee report) lxv 389, 1951; lxvi 407, 1952; lxvii 308, 1953; lxviii 345, 1954; lxix 392, 1955; lxx 422, 1956; lxxi 375, 1957; lxxii 402, 1958; lxxiii 380, 1959; lxxiv 359, 1960.
Specifications for prestressed concrete water storage tanks. (Committee report) lxxiii 391, 1959; lxxiv 372, 1960.
Specifications for steel pipe. (Committee report) lxv 393, 1951; lxvi 410, 1952; lxvii 311, 1953; lxviii 348, 1954; lxix 393, 1955; lxx 426, 1956; lxxiii 393, 1959.
Standard specifications for fire hydrants for ordinary water works service. A. W. W. A., N. E. W. W. A. lxvii Sept. 1953.
Standard specifications for the installation of cast iron water mains. (Committee report) lxxiv 360, 1960.
Standardization of pipe flanges and fittings. (Committee report) lxv 394, 1951; lxvi 411, 1952; lxvii 312, 1953; lxviii 349, 1954; lxix 394, 1955; lxx 427, 1956; lxxi 377, 1957; lxxii 404, 1958; lxxiii 382, 1959; lxxiv 361, 1960.
Tentative recommended practice for painting and repainting elevated steel water storage tanks, standpipes, and reservoirs. A. W. W. A. lxvi Dec. appended, 1952.
Tentative standard specifications for asbestos-cement water pipe. A. W. W. A. lxviii June 1954.
Tentative standard specifications for cement mortar lining of water pipelines in place sizes 16" and over. lxviii Dec., 1954.
Tentative standard specifications for cast iron pressure fittings. A. W. W. A. lxvii June appended, 1953.
Tentative standard specifications for installation of cast iron water mains. A. W. W. A. lxxi June appended, 1957.
Tentative standard specifications for reinforced concrete water pipe—non cylinder type, not prestressed. A. W. W. A. lxvi Mar. appended, 1952.
Tentative standard specifications for dimensions for steel pipe fittings. A. W. W. A. lxxi Mar. appended, 1957.
Tentative standard specifications for gate valves for ordinary water works service. A. W. W. A. lxvii March appended, 1953.
SPILLWAYS. See DAMS AND RESERVOIRS.
STANDPIPES. See TANKS.
STATISTICS. See ACCOUNTING AND RECORDS.
STERILIZATION. See TREATMENT (DISINFECTION).
STORAGE. See HYDROLOGY, QUALITY, RESERVOIRS, DAMS.
STREAM FLOW. See HYDROLOGY.
SUPPLY.
GENERAL:
A water resource program for Massachusetts. (C. I. Sterling, Jr.) lxxi 313, 1957.
Conservation, development and utilization of water resources. (Committee report) lxv 400, 1951; lxx 422, 1952; lxvii 314, 1953; lxviii 352, 1954; lxix 398, 1955; lxx 428, 1956; lxxi 380, 1957; lxxii 407, 1958; lxxiii 385, 1959; lxxiv 365, 1960.
Metropolitan district sources of water supply. (Warren A. Gentner) lxx 68, 1956.
Natural resources survey of New England and New York. (H. L. Fox) lxvi 43, 1952.
Public water supply resources of the Connecticut River Valley (A. Iantosca) lxxiv 285, 1960.
Public water supplies of Connecticut during the 1957 drought. (F. O. A. Almquist) lxxiii 1, 1959.
The experiences of New Britain with the 1957 drought. (G. W. Wood) lxxiii 15, 1959.

Water situation in New York City in 1950. (E. J. Clark) lxv 203, 1951.
MILITARY:
Portsmouth air force base water supply. (P. F. Howard) lxxii 17, 1958.
Water supplies for Army bases in Alaska. (W. L. Hyland and G. M. Reece) lxv 1, 1951.
See also DESCRIPTIONS OF VARIOUS WATER SYSTEMS AND SUPPLIES.
TANKS, STANDPIPES
Advantages of steel tanks for water storage. (J. A. Morley) lxxiii 172, 1959.
Construction of spherical and radial-cone elevated tanks. (J. E. Revelle) lxv 292, 1951.
Elevated tanks and standpipes. (Committee report) lxxiv 362, 1960.
Maintenance of steel water works tanks (G. A. Sampson) lxix 323, 1955.
Preload water tanks. (J. J. Closner) lxxii 302, 1958.
Prestressed water tanks. (F. X. Crowley) lxxii 317, 1958.
Revisions to steel water tank standards. A. W. W. A. lxix 424, 1955.
Steel standpipes and elevated tanks. (Committee report) lxix 395, 1955.
Steel storage-tank reconstruction of Sanford, Maine. (E. S. Littlefield and R. L. Meserve) lxxiii 336, 1959.
Tank-paint manufacturers' problems in the maintenance of steel water works tanks. (C. J. Gotthard) lxix 337, 1955.
The painting contractors' problems in the maintenance of steel water works tanks. R. O. Leonard) lxix 342, 1955.
The superintendents' problems in the maintenance of steel water works tanks. (A. M. Symonds) lxix 331, 1955.
TASTES AND ODORS. See QUALITY AND TREATMENT.
THICKNESS OF PIPE. See PIPE AND SPECIFICATIONS.
TREATMENT AND PURIFICATION.
GENERAL:
Application of ultra violet ray sterilization to water treatment. (F. W. Gilcreas and L. DeLalla) lxvii 130, 1953.
Automatic control of chemical addition (R. H. Babcock) lxxiv 189, 1960.
Automation in water treatment plants (R. H. Condell) lxxiii 233, 1959.
Believe-It-or-Not experiences with chemical feeders. (R. J. Leveque) lxviii 278, 1954.
Burlington water quality and treatment plant operation. (E. L. Tracy) lxxiv 113, 1960.
Control of tastes and odors at the Billerica water treatment plant. (B. E. Hawkes) lxxiv 236, 1960.
Desalting of saline waters: Review of present status. (E. W. Moore) lxv 319, 1951.
Detergent research related to water and sewage treatment. (F. J. Coughlin) lxx 298, 1956.
Factors influencing the efficiency of activated carbon. (A. Y. Hyndshaw, H. F. Laughlin, J. G. Filicky and D. C. Colebaugh, Jr.) lxvi 36, 1952.
Guides for selection of chemical feeders. (P. A. Coffman, Jr.) lxvii 192, 1953.
How to secure maximum benefits with activated carbon. (A. Y. Hyndshaw) lxix 69, 1955.
Investigation of liquid alum flow measurement. (K. F. Knowlton and R. H. Babcock) lxxiii 159, 1959.
Manganese removal with chlorine and chlorine dioxide. (A. E. Griffin) lxxii 321, 1958.
Modern trends in sea water conversion (J. J. Campobasso) lxxiv 1, 1960.
Re-chlorination in the Hartford distribution system. (A. J. Minkus) lxxii 251, 1958.
Treating algae under the ice at Westfield, Mass. (E. A. Snow, Jr. and A. Iantosca) lxvi 47, 1952.
Water quality and treatment. (Committee report) lxvi 404, 1952; lxix 387, 1955; lxxiii 378, 1955.
DISINFECTION:
A pilot plant for water treatment and its operation at Middleton Pond, Mass. (W. B. Davis and H. J. Steinhurst) lxxiv 124, 1960.
A tentative procedure for disinfecting water mains. A. W. W. A. lxviii June, 1954.
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O'HARA, FRANCIS N.
Electrolysis as it affects the water works superintendent. lxxiii 135, 1959.
Pressure and volume survey in Arlington, Mass. lxxi 188, 1957.

PALMER, C. MERVIN
Algae and other interference organisms in New England water supplies. lxxii 27, 1958.
PAUL, GEORGE E.
Construction of Mianus River dam and Reservoir for Greenwich Water Co. lxxi 20, 1957.
PETTERSEN, G. A.
Description of installation of automatic diatomaceous-earth filters at Saratoga, California. lxxiv 245, 1960.
PICTON, WALTER L.
Highlights of the defense program and controlled materials plan as affecting water works. lxvi 129, 1952.
PIRNIE, MALCOLM
Domestic and industrial water supplies face the pollution problem. lxviii 250, 1954.
PITTENDREIGH, L. M.
Recent improvements to the water supply works of Mansfield, Mass. lxvi 236, 1952.
POTTER, HOWARD H.
Sanitary supervision of Maine water supplies. lxvi 190, 1952.
PREE, H. L. JR.
Geologic factors affecting the yield of rock wells in southern New England. (With W. B. Allen and R. V. Cushman) lxvii 77, 1953.

RANKIN, R. S.
Developments in equipment for water works in New England. lxxii 190, 1958.
REECE, G. M.
Water supplies for Army bases in Alaska. (With W. L. Hyland) lxv 1, 1951.
REED, CLARENCE H.
Chlorination and bacterial problems in the distribution system. lxvi 279, 1952.
REVELLE, J. E.
Construction of spherical and radial-cone elevated tanks. lxv 292, 1951.
RINALDO, THOMAS J.
Chlorination experiences during the 1954 hurricanes. lxix 264, 1955.
RISBRIDGER, CHARLES A.
Current affairs in the water supply service in England and Wales. lxxiii 177, 1959.
ROGERS, SHERMAN L.
Cost of operating construction equipment. lxv 88, 1951.
ROOT, DARRELL A.
Determination of charges for public fire protection. (With T. R. Camp) lxix 90, 1955.
Determination of charges for public fire protection. lxx 199, 1956.
RUBIN, LAZARUS
A rapid method for the determination of fluorides in water. lxvi 97, 1952.
RULING, ALBERT H., JR.
Maintenance of power-distribution equipment. lxix 173, 1955.
RYCKMAN, DEVERE W.
Synthetic detergents and public water supplies. (With C. N. Sawyer) lxxi 262, 1957.

SAMPSON, GEORGE A.
Maintenance of steel water works tanks. lxix 323, 1955.
SAWYER, CLAIR N.
Synthetic detergents and public water supplies. (With D. W. Ryckman) lxxi 261, 1957.
SCALES, HAROLD B.
Maintaining pipeline coefficient "C" after water main cleaning. (With W. D. Monie) lxxi 203, 1957.
SCOTT, WARREN J.
Experiences with public water supply damage in the Connecticut flood disaster of 1955. lxx 275, 1956.
Progress and experience with fluoridation in Connecticut. lxvi 87, 1952.
Seventy-five years of water works progress in Connecticut. lxxii 127, 1958.
SHAW, PERCY A.
Sawmill operations and marketing of forest products. (With A. J. Christie) lxvi 104, 1952.
SHEA, WALTER J.
Seventy-five years of water works progress in Rhode Island. lxxii 134, 1958.
SHERIDAN, PHILIP W.
West Springfield's water supply. lxxiii 111, 1959.
SIGWORTH, E. A.
Taste and odor problems in the United States. lxxiii 224, 1959.
SILLIMAN, FREDERICK B.
The development of a large well supply. lxviii 158, 1954.
SKRINDE, R. T.
Experimental studies of corrosion control by silicates. (With R. Eliassen and W. B. Davis) lxxiii 294, 1959.
SLANETZ, L. W.
Membrane filters and their use for the bacteriological analysis of water. lxvi 335, 1952.

SMALL, RICHARD G.
Water works accounting. lxxiii 213, 1959.
SMITH, A. G.
Problems of corrosion. lxix 24, 1955.
SNOW, ERNEST A., JR.
Non-standard methods of analysis. lxix 9, 1955.
Observations on the nitrite test. lxxi 165, 1957.
SNOW, ERNEST A.
The detection of traces of materials in water with spot tests. lxxiv 250, 1960.
The most troublesome algae in New England waters. lxxii 328, 1958.
Treating algae under the ice at Westfield, Mass. (With A. Iantosca) lxvi 47, 1952.
SNOW, RUSSELL.
Nursery practice and watershed planting at Quabbin Reservoir. lxvi 111, 1952.
SOSCIA, B. L.
How supervisory control can help New England water systems. lxxiii 89, 1959.
SOULE, RALPH M.
Radiation experiences in Massachusetts water supplies. lxix 181, 1955.
The new gas transmission lines in Massachusetts in relation to public water supplies. lxvi 228, 1952.
SPINK, LELAND K.
Realistic limitations of flow-measurement rangeability and tolerance. (With R. C. Tamm) lxx 53, 1956.
STANLEY, WILLIAM E.
Peak demand loads in water supply systems. lxv 217, 1951.
STEINHURST, H. J.
A pilot plant for water treatment and its operation at Middleton Pond, Mass. (With W. B. Davis) lxxiv 124, 1960.
STERLING, CLARENCE L., JR.
A water resource program for Massachusetts. lxxi 313, 1957.
Seventy-five years of water works progress in Massachusetts. lxxii 138, 1958.
Water supply developments in the other American republics. lxv 286, 1951.
STRADLING, FRED P.
Obstacles encountered at plants of Bristol Water Co., during hurricanes "Carol" and "Edna." lxix 236, 1955.
SWARTZ, SAMUEL O.
Review of microörganisms in water supplies. lxix 217, 1955.
SWEENEY, JAMES A.
Water meters. lxv 159, 1951.
New billing practice at Manchester. lxvi 61, 1952.
SYMONDS, ALLEN M.
Experience with plastic service pipe. lxviii 217, 1954.
The superintendent's problems in the maintenance of steel water works tanks. lxix 331, 1955.
TAMM, RICHARD C.
Realistic limitations of flow-measurement rangeability and tolerance. (With L. K. Spink) lxx 53, 1956.
TRACY, EDWARD L.
Burlington water quality and treatment plant operation. lxxiv 113, 1960.
New asphalt lined reservoir for Rutland, Vt. lxix 314, 1955.
Seventy-five years of water works progress in Vermont. lxxii 143, 1958.
TRAGER, LEONARD W.
Functions, duties and authorities of public health service on water pollution control. lxv 119, 1951.
TRIPP, NORMAN R.
The management of forested watersheds in New England. (With H. W. Lull) lxxii 341, 1958.
TROWBRIDGE, C. E.
The Barrington station of Bristol County Water Co., R. I. (With O. F. Bixler) lxix 140, 1955.
TURCOTTE, DAVID H.
Odors and taste in public water supplies. lxviii 181, 1954.
Water purification in Cambridge, Mass. lxix 191, 1955.
TURNBULL, FRANK J.
How the Taunton pumping station was modernized. lxxi 296, 1957.
TURNER, HOWARD M.
Recent developments—The Cambridge water supply. lxvi 142, 1952.
WESTON, ARTHUR D.
Sanitary protection of watersheds—Are we overdoing or underdoing it? lxv 256, 1951.
WILCOX, CARL J.
Present day uses of cone valves. lxv 249, 1951.
WILLIAMS, THOMAS B., JR.
Water system improvements at Taunton, Mass. lxxi 291, 1957.
WINTERS, GEORGE R.
Wakefield's water emergency and solution. lxxii 335, 1958.
WOLFE, THOMAS F.
Current specifications for cast iron pipe and how to order to specifications. lxxi 130, 1957.
Mechanical joint cast iron pipe. lxix 278, 1955.
WOOD, GEORGE W.
Ground water supply for New Britain, Conn. lxv 143, 1951.
Fluoridation experience in New Britain. lxvi 82, 1952.
The experiences of New Britain with the 1957 drought lxxiii 15, 1959.
WOODHULL, RICHARD S.
Tastes and odors in Connecticut water supplies. lxix 126, 1955.